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FORENSIC MEDICINE.

BIO-THANATOLOGICAL.

MEDICAL
JURISPRUDENCE
FORENSIC MEDICINE
AND
TOXICOLOGY

BY

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VOLUME TWO.

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FORENSIC MEDICINE.

BIO-THANATOLOGICAL.

First, is the stain a blood stain, or does it contain blood? Second, if a blood stain, does the blood come from a bird, fish, reptile, or from a mammal? Third, if the blood is mammalian blood, did it come from any given species of mammal? This question usually assumes the form of whether the stain is a human blood stain or that of some animal. In some cases the data given are such that the question only arises as between human blood and that of some specified animal. It is sometimes alleged, for instance, that the blood is that of a chicken, fish, pig, horse, ox, or sheep, in which case the expert is only called upon to decide between a stain made by human blood and that of the animal mentioned. In other cases, however, no data are given, and the expert must state whether his examination has given results which show that the blood in the stain examined is, or is not, consistent with its having originated from a human being.

The methods employed for the identification of blood stains are: First, chemical; second, optical; third, microscopical examination for the identification of the blood corpuscles, or a combination of all of these methods of investigation. But before considering these in detail it is necessary to take up some of the physical and other properties of the blood, which may have a very important bearing in certain medico-legal cases.

COMPOSITION OF THE BLOOD.

The blood consists of a very pale, straw-colored, almost colorless, fluid called the blood plasma, in which are suspended a large number of minute solid bodies called the blood corpuscles, and also some still smaller bodies, the blood plates (platelets or plaques), which as yet have no importance in the medico-legal testing of stains. These blood plates which were first described by Hayem,[1] and Bizzozero,[2] are only found in mammalian blood, and are considered to exert some influence which results in the formation of fibrin. The **blood plasma** consists of the serum and the fibrin, the latter being made up of two albuminous bodies: the fibrinogenous substance and paraglobulin, sometimes called the fibrino-plastic substance. It is by the union of these two latter substances that the coagulation of the blood is

[1] "Du Sang," Paris, 1889.

[2] Virchow's Archiv, xc., 261.

due after it has been withdrawn from the blood-vessels. The plasma and the blood serum have practically the same density, the specific gravity being from 1,027 to 1,028. The serum is the fluid which remains after the separation of the coagulum, and consists of a solution in water of various inorganic salts, the principal ones being the sodium chloride and carbonate, and of several forms of albumin, the principal one of which is serum albumin, besides traces of various substances which have no practical value in the identification of blood stains medicolegally.

The **blood corpuscles** which are suspended in the plasma are of two kinds, the red and the white. The **red corpuscles** form, according to C. Schmidt, about one-half of the bulk of the blood (513.04 parts per thousand), and have a specific gravity of about 1,088. They contain the coloring matter hæmoglobin, which imparts the red color to the blood when seen in bulk, this color varying somewhat as the hæmoglobin is combined loosely with oxygen or not; this explains the bright scarlet red of arterial blood where the oxygen is combined with the hæmoglobin, and the dark cherry-red color of venous blood where the hæmoglobin has been deprived of its oxygen. These compounds are called oxy-hæmoglobin and hæmoglobin. The red color of the red corpuscles is due to the refraction of the hæmoglobin, since when the red corpuscles are seen under a microscope, they are not red but yellow. The number of red corpuscles varies according to circumstances, and is variously estimated. The majority of authorities agree, however, that in the healthy human adult there are about five million in a cubic millimetre. The number varies somewhat under different circumstances in health, and differs much from the normal in many diseases. The number also varies in different mammals: in the rabbit, according to Wormley, the number is three million five hundred thousand per cubic millimetre, and in the goat, in which the diameter of the corpuscle is only about one-half that of the human, the number is eighteen million per cubic millimetre. Taking the estimate of five million as the average number per cubic millimetre, one grain of human blood would contain about three hundred and twenty-five million red corpuscles, and the weight of a single corpuscle would be, approximately, one eight hundred millionth of a grain (Wormley).

The microscopic appearance of the red corpuscles in the blood of different animals will be described later under the head of the microscopic examination of blood.

The **white corpuscles,** also called leucocytes, are larger and lighter than the red corpuscles, and are present in the blood in a smaller number, there being about one white to five hundred red corpuscles in health, although in some diseases the proportion of the white may be very much increased, even to one white to two red corpuscles. The white corpuscles are considerably larger than the red, being about $\frac{1}{2,500}$ of an inch in diameter. They are colorless, or nearly so, somewhat granular, and have generally two or more nuclei which are rendered more distinct by treating them with dilute acetic acid. They are capable of undergoing changes in their form (amœboid) under certain circumstances. They have the same character and appearance in all kinds of blood and, therefore, have no value in distinguishing the blood of one animal from that of another. It is estimated that the blood forms about one-thirteenth of the total weight of the body in man.

Coagulation of Blood.—When blood has been drawn from the vessels it is seen very quickly to assume a jelly-like appearance and soon to solidify, the solid red mass gradually contracting and becoming covered with, and surrounded by, a comparatively colorless fluid. The solid mass is the coagulum or clot, and contains the fibrin and all of the solid elements of the blood, the corpuscles and plates. The liquid surrounding the clot is the serum. It is probable that the blood plates are essential in the formation of the clot, since under the microscope the filaments of fibrin may be seen starting in all directions from the plates. The coagulation of the blood is sometimes of medico-legal importance in certain cases. The time required for the coagulation of blood varies somewhat under different circumstances and in the blood of different animals; the blood of the horse, for instance, coagulates very slowly. Generally in man the coagulation begins in three to four minutes and is complete in seven or eight minutes.[1]

According to Nasse[2] the time required for the beginning of the coagulation in different animals is as follows:

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[1] Hewson's Works, Sydenham Soc., London, 1846.

[2] Nasse, Article Blut, Wagner's "Handwörterbuch d. Physiologie," vol. i.

The blood of the fowl begins to coagulate in one and one-half minutes; the blood of the pig, sheep, and rabbit in one-half to one and one-half minutes; in the dog from one to three minutes; in man from three to four minutes; in the horse and ox from five to thirteen minutes. Nasse gives the time for the completion of the coagulation in man as nine to eleven minutes. In cold-blooded animals the coagulation is slow and the clot small, while in birds the coagulation is rapid and the clot large.

The coagulation of blood may be hastened, delayed, or even prevented by various conditions. It is hastened by heat, a temperature slightly above that of the body; exposure of a comparatively large surface of blood to the air; collection in shallow dishes; dilution with less than twice its bulk of water; and especially by contact with numerous points of some foreign substance, as by stirring or beating with a number of wires. The conditions which usually obtain in the case of blood stains subjected to medico-legal investigation tend to hasten the coagulation of the blood, since it generally falls upon some foreign substance in the shape of spatters or small drops, so that a much larger surface is in contact with a foreign body and a comparatively large surface is exposed to the air.

On the contrary, the coagulation of blood may be delayed by certain conditions. It is delayed by cold; if freshly drawn blood be rapidly cooled to 0° C., it does not coagulate for one hour or more. A drop or pool of blood, therefore, if exposed to a very low temperature may be prevented from coagulating for a comparatively long period. The time required for the coagulation of blood may be of importance in some medico-legal cases as throwing light as to the exact time when the bleeding occurred, and in such cases the temperature to which the blood in question was exposed should have due consideration.

Contact of blood with oil or with greasy substances, especially if the blood be covered with the oil, will delay its coagulation. The addition of syrupy fluids or substances to blood tends to delay its coagulation. And since the presence in the blood of calcium salts is necessary for its proper coagulation, the addition to freshly drawn blood of a considerable quantity of any neutral salt, which will withdraw the calcium from it, such as the sulphate of sodium, the sulphate of magnesium, or the oxalate of ammonium, will indefinitely postpone its coagulation. Heating the blood immediately to 56° C. (130° F.) will prevent coagulation.

Drying of Blood.—The time required for the partial or complete drying of a spot or pool of blood may have very great importance in a medico-legal case as affording some light as to the time at which a murder has been committed. In a recent case of double murder now (April, 1893) under legal investigation, this question proved of very great value as tending to show that a considerable period of time had elapsed between the death of the two victims. Of course, those conditions which influence the drying of other fluids, such as the degree of temperature and the humidity of the atmosphere, also influence the drying of blood. The character of the surface upon which the blood falls will also influence the rapidity of drying. If a drop of blood falls upon a non-absorbent surface, like a piece of glass or painted wood, it will dry much more slowly than if it is easily absorbed by the material upon which it has fallen, such as linen or cotton cloth. In this connection it must be borne in mind that blood by virtue of its speedy coagulation, in which condition it partakes of the nature of a viscous fluid, is not absorbed so readily by a very absorbent material as a non-coagulable fluid, and therefore it dries more slowly than a corresponding amount of water. A large quantity of blood dries more slowly than a small quantity. A drop of blood dropped from the end of a finger on to a piece of glass, the drop measuring three-eighths of an inch in diameter, under conditions favorable for rapid drying—a room with an open fire and a temperature of 71° F.—began to show a slight contraction at the edge in ten minutes. In twenty-five minutes this contraction at the edge was very noticeable, and in thirty-five minutes the drop had partially dried to a point midway between edge and centre. In one hour it had dried except a small spot in the centre. This disappeared in five minutes more, although the stain was decidedly sticky to the touch, but in one hour and ten minutes the drop was completely dry. A drop of similar size dropped on cotton cloth was completely dry in one-half an hour. Under somewhat less favorable circumstances, in my laboratory, with a temperature of 65° F., a drop of blood of the same size dropped on a piece of planed soft-pine board did not undergo any perceptible change in its appearance for one-half an hour; in one hour it had just begun to shrink and have a glazed appearance at the edge. This appearance gradually extended from the edge toward the centre, and in just two hours the moist appearance at the centre disappeared. These experiments show that under ordinary favorable conditions for drying, a single drop of blood on a non-absorbent surface may require from one to two hours before the surface presents a dried appearance.

On account of the viscous nature of the blood after it has coagulated or jellied, it is often possible to determine the direction from which the blood came in certain stains. When blood spurts from an artery, or is driven from a wound by a blow with some blunt instrument, such as a club, it strikes any object with which it comes in contact with more or less force, and makes an oval or pear-shaped stain, and the bulk of the fluid is driven to the farther end of the stain; this is usually the smaller end and forms the stem of the pear in some stains. Sometimes, if the blood be driven with much force, a part of the drop will leave the main body and skip over the surface one or more times, making one or more minute spots beyond the end of the stem of the pear in the pear-shaped stains. This peculiar shape of the stains will, when it exists, show the direction from which the blood issued, even if it has impinged upon a perpendicular surface and has had a direction from below upward. If this perpendicular surface happens to be rough, like an overcoat made of rough cloth, the coagulation of the blood will usually take place so rapidly that the bulk of the fluid cannot gravitate to the lower part of the stain, and the upper and narrower part of the stain will contain the larger portion of the blood. On a smooth surface, however, the coagulation is usually not sufficiently rapid to prevent the gravitation of the larger portion of the blood to the lower part of the stain. The importance of being able to determine the direction from which blood came in certain cases is self-evident.

The accompanying photograph (Fig. 1) will serve to illustrate the points mentioned above, the arrows indicating the direction from which the blood came.

The constituents of the blood which are tested for in medico-legal investigations of blood stains, and in fluids containing blood, are the red coloring matter contained in the red blood corpuscles, the hæmoglobin, or one of the products of its decomposition, and the serum albumin of the blood serum. The hæmoglobin is tested for by both chemical and optical methods; the serum albumin only by chemical tests. These constituents are universally present in the blood of all animals, and therefore their detection does not throw any light upon the question as to the nature of the animal from which the blood came. The hæmoglobin is the important constituent, and the detection of it, or one of its decomposition products, is positive proof of the presence of blood of some kind. The detection of the albumin is comparatively unimportant, and serves only as a confirmatory test; its detection alone does not prove the presence of blood, since it is also present in the white of egg and other substances. The difference between egg albumin and serum albumin is so slight that no test which could be applied to objects which

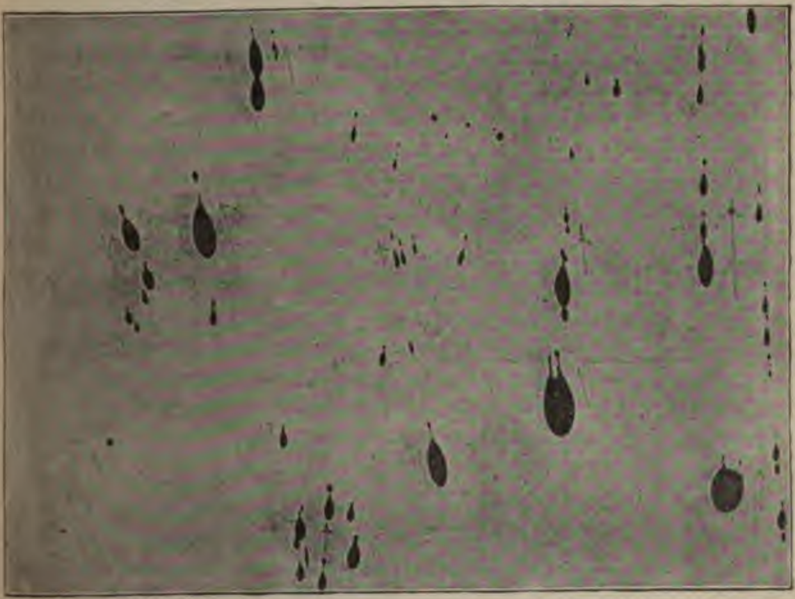

FIG. 1.—Blood Spatters on Paper. Natural size.

come under investigation in medico-legal cases would serve to distinguish between them.

Properties of Hæmoglobin.—Hæmoglobin is the red blood pigment which is present in the blood of all vertebrates and many of the invertebrates, and acts as the oxygen-carrier to the tissues. It is contained in corpuscles in all of the vertebrates except the *amphioxus* and *leptocephalus*,[1] and in some of the crustaceans, molluscs, insects, and worms. In most of the invertebrates it is present in solution in the blood serum.

Hæmoglobin unites with oxygen, carbonic oxide, and nitric oxide to form different compounds which are crystallizable, although these crystals are practically of no importance from a medico-legal point of view. With oxygen it forms two compounds, oxy-hæmoglobin and methæmoglobin, both of which have the same centesimal composition and the same crystalline form, but the color of their solutions is different, that of the oxy-hæmoglobin being red, and that of the methæmoglobin being brown; these solutions give different spectra, which will be described later under the spectroscopic tests for blood. Methæmoglobin with oxy-hæmoglobin is sometimes found in the blood and in the urine in certain diseased conditions, as in hæmoglobinuria, and after large doses of potassic chlorate.

Hæmoglobin unites with carbonic oxide and nitric oxide to give definite compounds, carbon monoxide-hæmoglobin and nitric oxide-hæmoglobin. Carbon monoxide-hæmoglobin has a medico-legal importance in connection with carbon monoxide poisoning, but very little in connection with blood stains. It is a much more stable compound than oxy-hæmoglobin and has a peculiar bright cherry-red color, so familiar to medical examiners who have seen the blood in cases of carbon monoxide poisoning due to the inhalation of illuminating gas, which nowadays contains so large a percentage of water-gas which is rich in carbon monoxide. Hæmoglobin contains iron.

Decomposition of Hæmoglobin.—When a solution of hæmoglobin is heated to the boiling point of water, or only to 70° C., the pigment is decomposed with the formation of an albuminous body, called globin, which is coagulated at this temperature, and a pigment called hæmatin, which contains all of the iron of the hæmoglobin. This same decomposition may be effected in several other ways, as by the action of acids or alkalies, in which case the globin is not precipitated as a coagulum, but remains in solution as acid or alkali-albumin.

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[1] Lankester, Proc. Royal Soc., xxi., 1872, p. 71.

Hæmatin is a brown pigment and is important, since it is the product of the reactions obtained in performing some of the principal tests for blood in blood stains, particularly the hæmin and the tungstate of sodium tests. Its solutions give characteristic spectra when examined with the spectroscope, and will be described later in connection with the spectroscopic tests for blood. Hæmatin is readily soluble in alkaline hydrates and in alcoholic sulphuric acid, but is insoluble in water, alcohol, and ether. If an alkaline solution be treated with the sulphide of ammonium, another pigment called hæmochromogen is formed which is due to the reducing effect of the sulphide of ammonium. This pigment has also been called reduced hæmatin, and it can be converted again to hæmatin by oxidation. If hæmatin be treated with reagents which will remove its iron, or if it be heated to a sufficiently high temperature, another decomposition product is formed, called hæmatoporphyrin, or iron-free hæmatin (Hoppe-Seyler). Hæmatoporphyrin gives a characteristic spectrum which is important in certain medico-legal cases. These decomposition products are of value from a medico-legal point of view, since it sometimes happens that blood stains are accidentally, or intentionally, subjected to the action of certain influences which decompose both the hæmoglobin and the hæmatin, so that the ordinary chemical tests will not suffice to detect the blood in the stains; it may also happen that the corpuscles also have been destroyed by the action of moisture or some other condition. Hence it is possible that the recognition of a blood stain may depend entirely on the identification of one of these decomposition products by means of the spectroscope. The recent studies of Liman, Kratter, and Hammerl[1] have shown some of the conditions which will prevent the detection of blood in blood stains by the application of the ordinary tests, and render necessary the examination of the stains for these other decomposition products—hæmochromogen and hæmatoporphyrin. The action of high temperatures is especially apt to thus decompose the blood pigment. Professor

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[1] Vierteljahrsch. f. ger. Med., 1892, iv., pp. 44-61 and 62-75.

Liman[1] refers to a case in which the ironing of a blood-stained cloth with a hot iron so changed the character of the blood that the coloring matter would not dissolve in water or other solvents ordinarily used in testing blood stains, and no reactions could be obtained by applying the ordinary tests, the guaiacum and hæmin tests. Subsequently Katayama[2] found that if a blood stain be heated only to 100° C. for one hour, it is readily soluble in water and the usual solvents, and its detection by the common tests is not prevented. If heated to 120° C. for one hour, it becomes insoluble in water or saturated borax solution, although Hammerl found[3] that these solvents, if allowed to act several days, will take up enough color to permit of the spectroscopic test; it yields its color readily to dilute sodium hydrate and alcoholic sulphuric acid. If heated to a temperature from 140° C. to 180° C., it is slightly soluble in ammonia and alcoholic sulphuric acid and quite soluble in dilute sodic hydrate and glacial acetic acid. He found glacial acetic acid and dilute sodic hydrate to be the best solvents for heated blood stains, and next in order came alcoholic sulphuric acid. These solutions gave the spectra of hæmochromogen. Hæmin crystals could sometimes be obtained after heating to 120° C., only rarely if heated to 140° C., and never if heated to 160° C. A temperature of 140° C., therefore, appeared to be the limit beyond which hæmin crystals could never be obtained. This temperature may be reached by ironing with a hot iron, or it may not. If the blood stain be dry before the heat is applied, the blood corpuscles will not be destroyed, but, on the contrary, will be fixed by the heat so as to be unaffected by water or other fluids which usually destroy them. If, however, the blood stain is wet when the heat is applied, or if the blood be in a liquid state, a temperature of even 56° C. will destroy the corpuscles. Hammerl found that the limit beyond which the hæmin test could no longer be obtained was 142° C. for one hour, and that for the guaiacum test was 135° C. for one hour. The longer the blood stain has been heated, the greater is the difficulty with which it is affected by the ordinary solvents, even though the temperature has not gone above 100° C. Hammerl found that the best solvents for blood which had been heated to a high temperature were concentrated hydrochloric acid, sulphuric acid, and glacial acetic acid, and that alcoholic sulphuric acid would always extract a sufficient amount of coloring matter for spectroscopic examination. Concentrated sulphuric acid will always extract pigment from heated stains, and this solution will always give the hæmatoporphyrin spectrum. Hammerl also found that if blood was subjected to the action of direct sunlight, the oxy-hæmoglobin spectrum could not be detected after ten days' exposure. After that only the spectrum of methæmoglobin could be seen. A piece of blood-stained linen exposed to the direct sunlight for five days became a faded gray color on the upper surface, and after about three weeks no blood corpuscles or hæmin crystals could be obtained. Blood dried in thin layer on glass was not affected by direct sunlight in three weeks.

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[1] Virchow's Archiv, civ., 1886, p. 394.

[2] Vierteljahrsch. f. ger. Med., xlix., p. 269.

[3] *Loc. cit.*

I have found that other influences besides a high degree of temperature will decompose the hæmoglobin in the same way, so as to prevent the detection of the blood by the ordinary chemical tests—the guaiacum and hæmin tests—and will not destroy the blood corpuscles. If a blood stain on clothing be treated with naphtha for some time, as I have had occasion to do in some cases for the destruction of vermin, or if it be treated with chloride of aluminium or bromo-chloralum, so commonly used as disinfectants and deodorizers, the same decomposition will occur as is caused by high temperatures.

THE CHEMICAL EXAMINATION.

In medico-legal cases, as has been mentioned above, the methods employed for the detection of blood in stains are chemical, spectroscopic, and microscopic. The chemical tests of importance are:

1. Teichmann's, or the hæmin test.
2. Tungstate of sodium test.
3. Guaiacum test.
4. Albumin test.

Of these the two former are the most valuable, although the guaiacum test is much used, particularly as a preliminary and confirmatory test.

The Hæmin Test, or Teichmann's Test.—This is the principal chemical test for blood pigment, and depends upon the obtaining of crystals of a halogen salt of hæmatin; these are called hæmin crystals. It is an exceedingly delicate test and serves to detect blood pigment in an infinitesimally small quantity of blood. It may be performed in the following manner: If the spot to be tested is a dry blood stain, a very small fragment of the blood is removed from the stain by the point of a knife and placed upon a glass slide. It is treated on the slide with a small drop of water in which has been dissolved a very small crystal of chloride of sodium (common salt) or, better, of iodide of potassium. It is then evaporated by means of gentle heat over a small flame to dryness, the dry residue covered with a covering-glass, and a drop of glacial acetic acid allowed to run under the covering-glass. The slide is heated gently until bubbles of gas are seen to form under the covering-glass, which shows that the glacial acetic acid has been heated to the boiling point; it is then removed and allowed to cool, when the hæmin crystals, which are soluble in boiling glacial acetic acid, will crystallize out and may be detected by their exceedingly characteristic form under the microscope. These crystals assume somewhat different shapes and sizes according to the

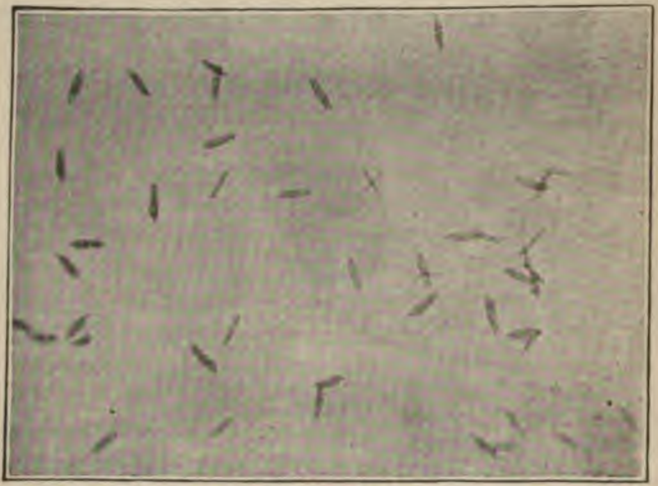

FIG. 2.—Hæmin Crystals. Common form. × 750.

rapidity with which they form. These hæmin crystals may consist of the chloride of hæmatin, the bromide, or the iodide of hæmatin, as I have proved by using the method which will be mentioned in considering the tungstate of sodium test. The accompanying photographs will show the different shapes which the hæmin crystals assume when crystallizing under various conditions (Figs. 2, 3, 4, and 5). Some of these crystals will be seen to be somewhat irregular and much larger than the others. The normal form, however, of the hæmin crystal is the dark brown, or yellowish, rhombic plate. Sometimes several crystals cross each other so as to form a cross or a rosette, as will be seen in the photographs. All of the photographs were taken from different parts of the same slide and with the same amplification. When these crystals are detected it is a positive proof of the presence of blood, from some animal or other, in the stain examined.

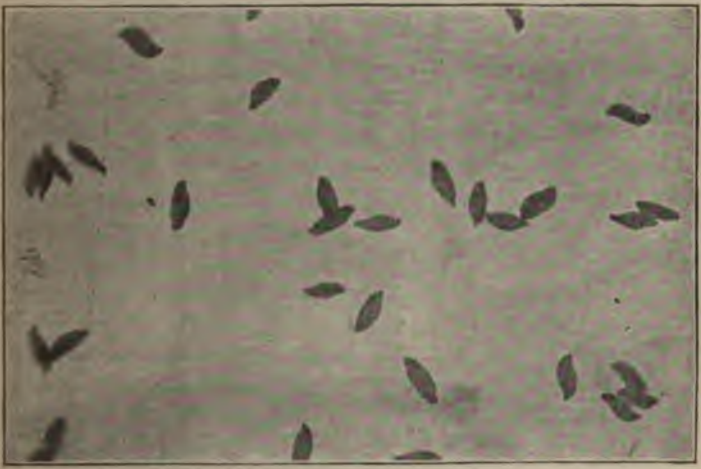

FIG. 3.—Hæmin Crystals. Large size. × 750.

PRECAUTIONS.—Care should be taken in heating the slide after the addition of the glacial acetic acid not to bring the fluid under the covering-glass to an active boil, since, if it is, the bubbles of gas will carry mechanically most of the crystals to the outside of the covering-glass, and they may in that way escape detection.

Care should also be taken not to heat the blood previous to performing the test to such a temperature that the hæmatin will be destroyed. If, as has been stated above, it be heated to a temperature of 142° C. for an hour, the hæmatin will become so decomposed that no hæmin crystals can be obtained by the performance of this test. If a blood stain has been soaked for several hours in naphtha, or if it has been treated with bromochloralum, or a strong solution of chloride of aluminium, so frequently used as a disinfectant, it will also prevent the detection of blood by any of the chemical tests. Under these circumstances, reliance must be placed entirely upon the microscopic examination of portions of the blood stains for the detection of the red blood corpuscles, which are not destroyed by these reagents or by the application of heat to a temperature of 142° C., and upon obtaining the spectroscopic test for hæmatoporphyrin.

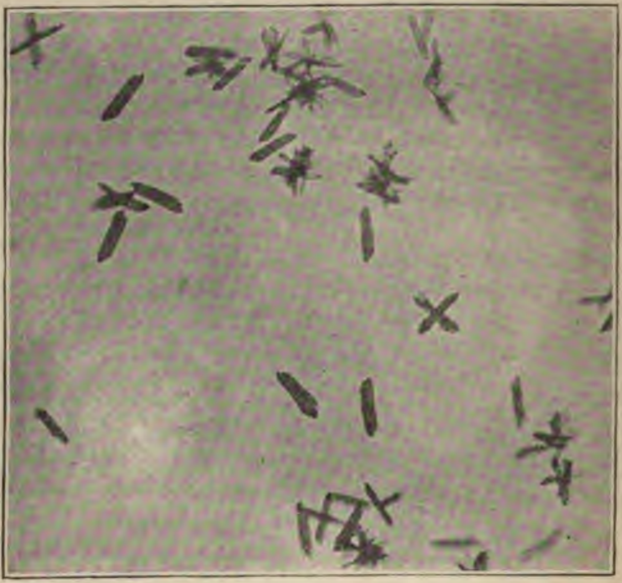

FIG. 4.—Hæmin Crystals in Groups. × 750.

I first observed this decomposition of the hæmatin by a temperature of 120° in attempting to obtain the hæmin crystals from a specimen of dried blood upon a glass slide which had been treated by Ehrlich's method for the examination of blood for clinical purposes. In that process the thin layer of dried blood corpuscles formed upon a thin covering-glass are heated to a temperature of 120° for from one-half to three-quarters of an hour, and then the peculiar staining fluids are applied. In testing the thin layer of blood thus treated before any staining fluid had been added, I was unable to obtain any hæmin crystals, although, as above stated, Hammerl[1] was able to obtain them sometimes if the temperature was not above 142° C. The blood corpuscles, however, are perfectly preserved so that they can be stained and distinguished readily under the microscope.

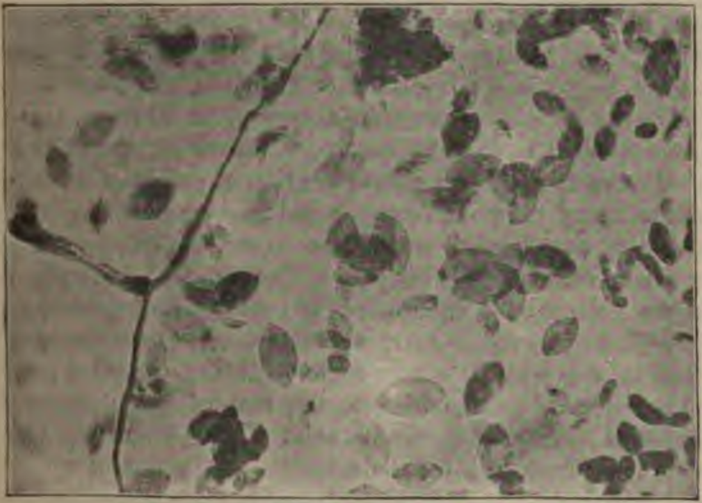

FIG. 5.—Hæmin Crystals. Unusual shape. Formed near the centre of a small clot. × 750.

This test is also applicable to coagulated albumin containing blood pigment. If a fluid is suspected to contain blood, it may be boiled in a test-tube so as to coagulate the albumin. The coagulated albumin will carry down mechanically any blood pigment that is in the fluid. This coagulated albumin may then be collected upon a filter-paper, a portion of it removed, placed upon a glass slide, treated in the same manner as a dried blood stain, and the hæmin crystals obtained. This is the usual method for the detection of blood pigment in urine, as in cases if hæmoglobinuria where there is only the blood pigment present in the urine, the microscopic examination of the urinary sediment failing to reveal the presence of any blood corpuscles in the sediment.

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[1] *Loc. cit.*

The Tungstate of Sodium Test.—This test is very valuable in the case of washed stains, or where the blood pigment is in solution in a considerable quantity of fluid, since it enables us to collect, and thus concentrate, the pigment in the form of a precipitate to which both the hæmin and the spectroscopic tests can be applied. If blood-stained clothing, or other substance, has been imperfectly washed, so that a small amount of blood is left, a portion of this diffused stain can be soaked in water, or, better, in a dilute solution of iodide of potassium, or, as preferred by most European chemists, in dilute cyanide of potassium solution, so as to dissolve whatever pigment has been left. I have found that a dilute solution of iodide of potassium dissolves blood pigment from an old stain better than water, but most of the German writers recommend a solution of cyanide of potassium for this purpose. The removal of the pigment from the cloth can be facilitated by rubbing and pressing the cloth with a glass rod. After the material has been thoroughly washed in this way, it can be removed, all of the fluid pressed out by wringing, and added to the rest of the fluid. This should then be filtered to remove solid particles and the filtrate collected in a flask or test-tube, according to its quantity. This should be strongly acidulated with acetic acid, and a few drops of a saturated solution of sodium tungstate, which has been strongly acidulated with acetic acid, added; if much blood is present so that the filtrate is deeply colored, then five or ten cubic centimetres of the sodium tungstate solution should be added. The fluid in the flask or test-tube should then be boiled for several minutes; if much blood be present, the sodium tungstate will give a light-colored bulky precipitate when first added, but upon boiling, this precipitate will aggregate together in dense flocculi and change to a chocolate color. If there is but a trace of blood pigment present, the sodium tungstate will produce merely a slight turbidity which will not change perceptibly in appearance upon boiling. In this case the flask or test-tube should be set aside for a day or two to settle. Then a light-brownish colored deposit may be seen on the bottom of the test-tube or flask, from which most of the supernatant fluid can be removed by decanting, and the remainder, containing the small quantity of precipitate, transferred to a watch-glass. By gently rotating the watch-glass the precipitate may be collected in a small volume at the bottom of the concavity of the watch-glass, and the supernatant fluid absorbed by folds of filter or blotting paper. In this way an exceedingly small quantity of precipitate can be washed, by adding water, again collecting the precipitate and absorbing the supernatant fluid as before with filter-paper. This precipitate suspended in a drop or so of water can be transferred to a glass slide and tested by Teichmann's test for hæmin crystals. If the precipitate is bulky, it can be collected on a filter, washed with water, dried, and preserved for the hæmin and spectroscopic tests; this precipitate can be preserved in a tube or bottle for an indefinite period and tested when convenient. A minute particle can be moistened on a microscope slide with a small drop of water in which a small fragment of sodium chloride or iodide of potassium has been dissolved, then evaporated by gentle heat to dryness; covered with a covering-glass, treated with a drop of glacial acetic acid in the usual way, warmed to the boiling point of the acetic acid, and then allowed to cool, when hæmin crystals will be seen on examination with the microscope. This precipitate will yield its color to dilute sodic hydrate or ammonic hydrate after some time, giving a brown solution, which when examined with a spectroscope will give the spectrum of hæmatin in alkaline solution. In this way blood pigment can be completely removed from urine or other aqueous fluids.

By this test it may be shown that the hæmin crystals may be formed by using a chloride, bromide, or iodide, and that these crystals of the hæmatin hydrochloride, hydrobromide, and hydriodide have the same crystalline form and appearance, in the following manner:

A tungstate of sodium precipitate should be collected on a filter, and washed with hot water until the wash-water gives no longer the slightest turbidity with nitrate of silver solution, which shows that all of the salt originally present in the blood with the blood pigment has been removed. It will then be found if a little of the precipitate be transferred to a glass slide, and moistened with a drop of distilled water, dried by gentle heat, and Teichmann's test performed without the addition of any salt, that no hæmin crystals will be formed, owing to the absence of the negative element of chlorine, bromine, or iodine to combine with the hæmatin to form the hæmin crystals. If now the test be repeated with portions of the same precipitate on three other slides, a small fragment of common salt (chloride of sodium) being dissolved in the distilled water on one slide, one of iodide of potassium on the second slide, and one of bromide of potassium on the third slide, crystals having the same crystalline form and appearance will be found after the completion of the test on all of the slides.

The Guaiacum Test.—If a solution of blood pigment be treated with a few drops of a dilute tincture of guaiacum, and then a drop or two of an ethereal or aqueous solution of the peroxide of hydrogen, an immediate blue color will be produced. The Dutch physician, van Deen, discovered in 1863 that a solution of the slightest trace of blood pigment obtained from a very old, as well as from a fresh, stain would be colored blue by the tincture of guaiacum and ozonized oil of turpentine; a solution of the peroxide of hydrogen, however, acts in the same manner as the ozonized oil of turpentine, and can be nowadays more readily obtained; it is also a cleaner reagent.

The test may be performed in the following manner:

A minute fragment of the stain should be placed in a white dish, a small evaporating dish or crucible, treated with a drop of water to dissolve the pigment, then a drop or two of the tincture of guaiacum added. If no blue color has resulted, it proves that no substance is present which, by itself alone, colors the tincture of guaiacum blue; then a few drops of the peroxide of hydrogen solution are added, when, if blood pigment were present, an immediate bright blue color is seen. A piece of filter-paper may be moistened and pressed upon the suspected stain, from which it will remove a sufficient quantity of blood pigment to give the reaction; in this case the reagents may be applied to the filter-paper directly. In the case of very old stains it is necessary to subject them to the action of water for a longer time in order to dissolve out the blood pigment. According to Wormley, a $\frac{1}{5000}$ solution of blood pigment will give a very distinct reaction. It is necessary that the tincture of guaiacum be freshly prepared at the time of each testing, and the guaiacum, from which the tincture is made, should be perfectly clear, and taken from the inside of a large piece of the resin.

Many other substances alone will produce the blue color with tincture of guaiacum, such as glue, casein, potato skin, and other substances; also many compounds of iron, such as the chloride, acetate, and citrate, will give a strong blue color, and, to a less extent, ferric hydrate, which may be contained in spots of iron rust on clothing; therefore this test is of no value in the detection of blood on rusty iron.

According to Huenefeld,[1] besides the salts of iron above mentioned, the following metallic compounds will also produce the blue color with the tincture of guaiacum: ferric sulphate, iron alum, cupric nitrate, cupric sulphate, the double chloride of gold and sodium, dioxide and peroxide of manganese, the permanganate of potassium, the color being a dark green to a greenish blue in the last case. Ferrous salts, if they contain no ferric compounds, have no action on the guaiacum. According to Wesener,[2] indigo will oxidize the guaiacum, and therefore the test is not reliable in the case of stains on cloth which has been dyed with indigo.

This test is, consequently, of value chiefly as a preliminary test to prove the absence in any given stain of blood pigment. A negative result shows that the stain does not contain blood pigment in such a form as to be soluble in the ordinary solvents, while a positive result is very untrustworthy, since so many other substances may produce the blue color with the tincture of guaiacum.

The Albumin Test.—This test is of comparatively little value; it is simply a confirmatory test and is usually incidentally obtained in performing Teichmann's test for blood crystals. It depends on the fact that if a solution of albumin, which is so large a constituent of the blood serum, be heated to about the boiling point of water, the albumin is precipitated as a white precipitate, it being converted into coagulated albumin. If there be present at the same time blood pigment, as is the case in solutions of blood or of blood stains, the coagulated albumin will be colored more or less brownish by the blood pigment which it removes from the fluid.

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[1] "Die Blutproben vor Gericht."

[2] North American Practitioner, Chicago, 1892, p. 364.

According to Wormley a $\frac{1}{1,000}$ solution of blood will show a marked turbidity. This coagulation of the albumin is usually seen in evaporating the drop of the solution of a blood stain on a glass slide in the first part of the performance of Teichmann's test for blood crystals. The precipitated albumin may be dissolved by a little dilute caustic potash or soda, which solution, if blood pigment is present, is dichroic, being reddish by reflected and greenish by transmitted light. The detection of albumin alone in this way does not serve to distinguish between blood and any other albuminous fluid.

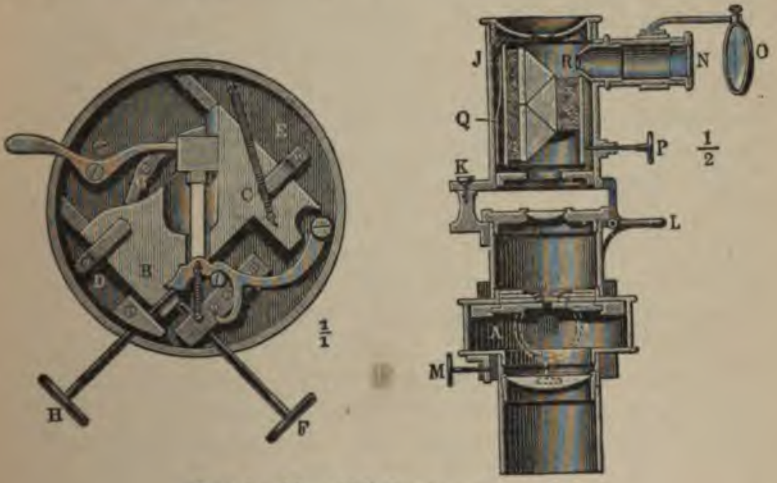
THE SPECTROSCOPIC EXAMINATION.

This test depends on the fact that solutions of hæmoglobin and of its various decomposition products, when placed before the slit of the spectroscope, absorb certain rays of light, giving rise to dark bands in the solar spectrum, called absorption bands, which vary according to the nature of the coloring matter present, since the solutions of the different pigments absorb different rays of light.

The peculiar bands of oxy-hæmoglobin were discovered by Hoppe-Seyler in 1862, and later it was learned that if oxy-hæmoglobin be deprived of its oxygen, a single band of hæmoglobin was formed in place of the two bands of the oxy-hæmoglobin. Still later, the peculiar bands of the other hæmoglobin decomposition products and compounds were discovered.

If a sufficient amount of blood is contained in the substance to be tested, whether in a liquid or dried condition, an ordinary spectroscope may be used. One of the most convenient instruments is Vogel's small direct-vision pocket spectroscope, which may be mounted on a block and provided with a prism and mirror so arranged as to give a second spectrum for comparison, one being of the suspected fluid and the other of a known solution of blood pigment. If the material to be examined contains a large blood stain or one made by the drying of a small pool of blood, there is no difficulty in obtaining a sufficient amount of a solution of the coloring matter to give a good spectrum with the larger instruments, but if we have only a small stain we must use one of the spectroscopic eye-pieces, usually called micro-spectroscopes, such as that of Sorby's or Abbé's. The accompanying figures show the arrangement of the Abbé spectroscopic eye-piece as manufactured by Zeiss of Jena.

This Abbé spectroscopic eye-piece consists of the drum, A, between the two lenses of an eye-piece, in which there is an adjustable slit worked by the screws H and F, which change either the length or the width of the slit. This slit may thus be opened sufficiently to permit a view of the whole field and a proper focussing of the object. The drum contains a comparison prism which takes light coming from an aperture at the side of the drum connected with a lateral frame and clips to hold the object, whose spectrum is to be compared with that on the stage of the microscope, and a mirror. Above the eye-piece is an Amici prism of great dispersion which revolves on the pivot K, so that it can be moved away from the eye-piece to allow of the adjustment of the object, or can be brought into position over it and kept in place by the catch L. At N is placed a scale which is adjusted by the screw P and the spring Q, and is illuminated by the mirror O. The divisions of this scale represent wave-lengths expressed in one hundred thousandths of a millimetre. In adjusting the scale the Frauenhofer line D, or the sodium line, should be made to coincide



Figs. 6 and 7.—Abbé's Spectroscopic Eye-Piece.

with the division line 58.9, which is the wave-length of the sodium line—five hundred and eighty-nine millionths of a millimetre.

Mr. Sorby[1] states that a sufficient amount of pigment can be obtained to give a good spectrum from a blood stain one-tenth of an inch in diameter, which weighs no more than $\frac{1}{1,000}$ part of a grain, by using a cell made of a piece of barometer tubing one-half of an inch long. With careful manipulation and adjustment he considers that a faint spectrum can be seen from the hæmoglobin contained in a single blood corpuscle. The method, however, recommended by the late Dr. Joseph G. Richardson, of Philadelphia, is one of great delicacy and in the writer's hands has given very satisfactory results. This method is described in a paper read by Dr. Richardson before the biological and microscopical section of the Academy of Natural Sciences, and is as follows:

"Procure a glass slide with a circular excavation in the middle, called by dealers a concave centre, and moisten it around the edges of the cavity with a small drop of diluted glycerin. Thoroughly clean a thin glass cover about one-eighth of an inch larger than the excavation; lay it on white paper, and upon it place the tiniest visible fragment of a freshly dried blood clot. This fragment will weigh from $\frac{1}{25,000}$ to $\frac{1}{50,000}$ of a grain. Then with a cataract needle deposit on the centre of the cover, near your blood spot, a drop of glycerin about the size of a small period, and with a dry needle gently brush the blood to the brink of your microscopic pond, so that it may be just moistened by the fluid. Finally, invert your slide upon the thin glass cover in such a manner that the glycerined edges of the cavity in the former may adhere to the margins of the latter, and, turning the slide face upward, transfer it to the stage of the microscope. By this method it is obvious that we obtain an extremely minute quantity of strong solution of hæmoglobin whose point of greatest density, generally in the centre of the clot, is readily found under a $\frac{1}{4}$-inch objective, and tested by the adjustment of the spectroscopic eye-piece. After a little practice it will be found quite possible to modify the bands by the addition of sulphuret of sodium solution as advised by Preyer.

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[1] Quarterly Journal of Science, vol. ii., p. 198.

"In cases of this kind, where the greatest possible economy, or even parsimony, of the material is needful, I would advise the following mode of procedure for proving and corroborating your proof of the existence of blood, so that its presence in a stain may be affirmed with *absolute certainty*.

"From a suspected blood spot upon metal, wood, paper, muslin, or cloth, scrape with a fine, sharp knife two or three or more minute particles of the reddish substance, causing them to fall near the middle of a large, thin glass cover. Apply in close proximity to them a very small drop of three-fourths per cent salt solution, bring the particles of supposed blood clot to its edge, and proceed as I have already directed.

"After thus examining the spectrum of the substance you may generally, by rotating the stage, cause the colored fluid to partly drain away from the solid portion, wherein, under favorable circumstances, should the specimen be blood, the granular white blood globules become plainly visible, as do also cell walls of the red discs. Among the latter, if your mental and physical vision is keen enough, you can, by the aid of a $\frac{1}{25}$ immersion lens and an eye-piece micrometer, measure a series of corpuscles accurately enough to discriminate human blood from that of an ox, pig, horse, or sheep."

The above method of Dr. Richardson can be modified by substituting other solvents in the place of the diluted glycerin or salt solution in case the hæmoglobin has been decomposed to hæmatin or hæmatoporphyrin.

Oxy-Hæmoglobin.—Solutions of oxy-hæmoglobin when examined with the spectroscope give different appearances according to the concentration of its solutions, the characteristic absorption bands only appearing when the solution has been properly diluted. Concentrated solutions absorb all the light except the red rays from about the Frauenhofer lines A to D. On diluting the solution, if the proportion of oxy-hæmoglobin is only about 0.75 per cent, some of the green rays between the lines *b* and F will be seen, if the layer of fluid examined be one centimetre in thickness, but most of the rays between the lines D and *b* will be absorbed, forming a single dark absorption band at this point. On diluting the solution still more this single dark band resolves itself gradually into two distinct bands, the narrower but darker and more clearly defined, called α, lying very near the line D, while the broader and less sharply defined, called β, lies near the line E. The appearance of these bands in solutions of different concentration is shown in the accompanying plate (Spectra 1, 2, 3, and 4, taken from Preyer, with the addition of the wave-length scale by Gamgee).[1]

Hæmoglobin.—Oxy-hæmoglobin can be readily deprived of the oxygen with which it is loosely combined, in several ways, by both mechanical and chemical means. The oxygen may be removed by exhausting it by a vacuum pump, or by subjecting the solution to a continuous current of some neutral gas, like hydrogen or nitrogen, or by treating it with some reducing agent, which will itself unite with the oxygen, such as a solution of ferrous sulphate, to which a small quantity of citric or tartaric acid has been added and then a trace of ammonia just to alkaline reaction (Stokes' reagent), or a dilute solution of sulphide of ammonium. This removal of the oxygen from oxy-hæmoglobin takes place in the tissues of the living body, changing the pigment from oxy-hæmoglobin of the arterial blood to hæmoglobin of the venous blood. A solution of hæmoglobin has a darker color than one of oxy-hæmoglobin, but if exposed to contact with air it very readily absorbs oxygen from the air, and becomes converted into the bright red solution of oxy-hæmoglobin. It has been estimated by Preyer[2] that one gram of hæmoglobin will combine with 1.27 c.cm. of oxygen at 0° C. and one metre pressure, which is equivalent to 1.67 c.cm. of oxygen at 0° C. and 760 mm. pressure.

When the oxy-hæmoglobin has thus been deprived of its oxygen, the color of the solution changes to the darker, purplish tint of hæmoglobin, and if the solution be examined with a spectroscope, it will be seen that the two absorption bands α and β have been replaced by a single band (called γ), which is not as distinct and sharply defined as either of the oxy-hæmoglobin bands, and occupies the space between that formerly occupied by the bands α and β, between the D and E lines. The position of this band may be seen in the plate (Spectrum 5).

Methæmoglobin.—This is also a compound of hæmoglobin and oxygen in which the oxygen is more firmly united with the pigment than in the case of oxy-hæmoglobin, so that it cannot

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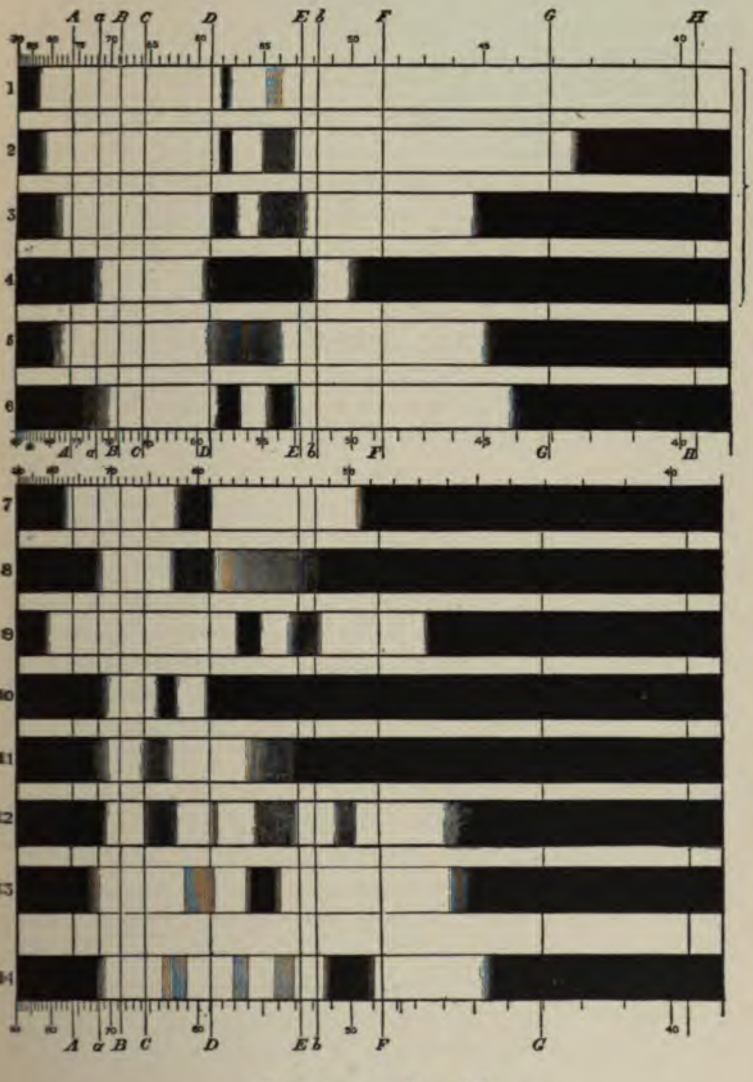
[1] "Physiological Chemistry of the Animal Body."

[2] "Die Blut Krystalle." Jena. 1871.

MEDICAL JURISPRUDENCE—PLATE III.



Explanation of Plate III.

Spectra 1, 2, 3, and 4, Oxy-hæmoglobin of various degrees of concentration; Spectrum 5, Hæmoglobin; Spectrum 6, CO-Hæmoglobin; Spectra 7 and 8, Hæmatin in alkaline solution of different degrees of concentration; Spectrum 9, Hæmochromogen (Stokes' reduced hæmatin); Spectrum 10, Methæmoglobin; Spectrum 11, Acid hæmatin (blood treated with acetic acid); Spectrum 12, Acid hæmatin in ethereal solution; Spectrum 13, Acid hæmatoporphyrin; Spectrum 14, Alkaline hæmatoporphyrin.

be removed by passing a stream of hydrogen or nitrogen through its solution. It may be formed from oxy-hæmoglobin by the action of some reagents, such as potassium permanganate, and it is sometimes seen in the living body, as in the urine in hæmoglobinuria, and in the blood and tissues in chlorate of potassium poisoning. Sulphide of ammonium changes it first to oxy-hæmoglobin and then to hæmoglobin. In an old blood stain, especially if it has been exposed to sunlight, some of the hæmoglobin, and in some cases all of it, is decomposed, and methæmoglobin is one of the pigments formed. By putrefaction oxy-hæmoglobin becomes converted into methæmoglobin. If a solution of methæmoglobin is examined with a spectroscope, a dark absorption band is seen in the red between C and D, lying nearer C than D (see Spectrum 10). If the solution be diluted, two other faint bands appear between D and E, occupying positions but slightly different from the two oxy-hæmoglobin bands; these two may be distinctly separated, or may be fused together according to the state of dilution. Still a fourth band in the blue has been described between *b* and F.

Carbon-Monoxide Hæmoglobin.—This compound, as has been mentioned above, has a medico-legal importance chiefly in cases of carbon-monoxide poisoning caused by the inhalation of illuminating gas or fumes from burning charcoal. The carbon monoxide forms with hæmoglobin a much more stable compound than does oxygen, and readily deprives the oxy-hæmoglobin of its oxygen. A solution of carbon-monoxide hæmoglobin, or the blood of a person who has been poisoned with carbon monoxide, has a peculiar bright cherry-red color, which appearance can be preserved for an indefinite period by mixing the blood with an equal volume of a concentrated solution of borax. Carbon-monoxide hæmoglobin resists putrefaction for a very long time, and, by preserving the blood in any given case of carbon-monoxide poisoning in the above manner, the peculiar appearance and the characteristic spectrum can be obtained even after a period of several years, as the writer has done in several cases of poisoning. Carbon-monoxide hæmoglobin gives a spectrum very similar to that of oxy-hæmoglobin, but the two bands are a little nearer the violet end of the spectrum. The two spectra can readily be distinguished from each other by treating the solution with sulphide of ammonium, which does not affect the carbon-monoxide hæmoglobin spectrum, but as has been mentioned, changes the oxy-hæmoglobin spectrum to that of hæmoglobin. The spectrum of carbon-monoxide hæmoglobin is shown in the plate (Spectrum 6).

Hæmatin.—This pigment becomes of importance in the medico-legal examination of blood stains in those cases in which the stains have been subjected to any of the various conditions which cause decomposition of the hæmoglobin and the formation of hæmatin. These conditions have been already spoken of (see p. 15 *et seq.*).

Since hæmatin is insoluble in water, alcohol, and ether, an acid or alkaline solvent must be used in those stains from which water does not extract any coloring matter. Hæmatin is readily soluble in any of the dilute alkalies, and is soluble only with difficulty in glacial acetic acid and an alcoholic solution of sulphuric acid. Alkaline solutions of hæmatin have a red color when viewed by transmitted light, if the solution is concentrated, and an olive-green color if it is dilute; acid solutions have a brown color. The hæmatin may be extracted from a blood stain by treating a portion of the stain with dilute sodic hydrate or ammonic hydrate, which will give the spectrum of an alkaline solution of hæmatin, or with glacial acetic acid, or an alcoholic solution of sulphuric acid, which will give the spectrum of an acid solution of hæmatin. Hæmatin in alkaline solution gives a spectrum which contains a dark band between the lines C and D, lying close to D, and, if sufficiently concentrated, overlapping D, and the violet end of the spectrum is strongly absorbed (see Spectra 7 and 8). Hæmatin in acid solution gives a spectrum containing an absorption band between C and D, lying very near and even up to the line C (Spectrum 11). A solution of hæmatin in alcoholic sulphuric acid, if of proper dilution, may show four absorption bands, one in the red between C and D lying nearer C than D, an exceedingly faint band which is not always visible just to the right of the line D, a third and quite broad band between D and E situated near E, and a fourth band between *b* and F, a little nearer *b* than F (Spectrum 12).

Hæmochromogen or Reduced Hæmatin.—By treating an alkaline solution of hæmatin with a reducing agent like the sulphide of ammonium or Stokes' reagent, a coloring matter, called reduced hæmatin, or hæmochromogen, is formed, which gives a well-marked and characteristic spectrum. This consists of a dark and sharply defined band about midway between D and E, and a second, fainter band which occupies the space between *b* and E, sometimes overlapping both of these lines. This alkaline solution of hæmochromogen readily absorbs oxygen when in contact with the air, and becomes converted into hæmatin (Spectrum 9).

Hæmatoporphyrin.—When hæmatin or hæmoglobin is heated with a very concentrated hydrochloric acid, or is dissolved in concentrated sulphuric acid, the pigment is deprived of its iron and a coloring matter obtained, which is called by Hoppe-Seyler hæmatoporphyrin, or iron-free hæmatin. The solution in concentrated sulphuric acid has a purple red color, and gives a spectrum containing two absorption bands, one a faint band to the left of D, and the second a dark, well-defined band between D and E (Spectrum 13).

When hæmatoporphyrin is dissolved in a dilute alkali, a reddish-brown solution is formed which gives a spectrum having four bands, one a faint band midway between C and D; a second and third, which are rather faint bands, occupy positions similar somewhat to the oxy-hæmoglobin bands α and β, and the fourth band is a wide, dark band extending from *b* nearly to F (Spectrum 14).

METHOD OF EXAMINATION.

The method to be employed in preparing a stain for spectroscopic examination must necessarily vary according to circumstances, and especially according to the quantity of material at our disposal, and also according to the age of the stain. If a stain is comparatively recent and contains plenty of material, it will readily yield its coloring matter to water or a dilute salt solution, and the resulting solution can be introduced into a small tube which can be placed in front of the slit of a direct-vision pocket spectroscope or can be placed in the clips in front of the lateral aperture in the spectroscopic eye-piece of Zeiss (above described), when the two oxy-hæmoglobin bands will be seen; then a little reducing agent can be added, sulphide of ammonium or Stokes' reagent, and the band of hæmoglobin obtained.

If we have only a small stain at our disposal the method of Dr. Richardson, above described, should be employed, using only a very minute fragment of coagulum or a small fibre of the stained material. If the oxy-hæmoglobin bands are seen, the minute drop on the cover may be treated with an equally minute drop of the reducing agent, and the band of hæmoglobin may be seen.

If the blood pigment has become decomposed, the spectrum of methæmoglobin may be obtained. If it has become so much decomposed as to be insoluble in water, a minute particle should be digested with dilute sodic hydrate, which will dissolve the hæmatin, and the solution will give the spectrum of hæmatin in alkaline solution. Another minute fragment may be digested with glacial acetic acid and the spectrum of hæmatin in acid solution obtained. By treating the dilute sodic hydrate solution with a minute drop of sulphide of ammonium, the spectrum of hæmochromogen will be seen. If the stain has been heated to a high temperature, as by a hot iron in the case of a stain on clothing, a minute fragment of the dried blood is first treated with a very small drop of concentrated sulphuric acid, which will always extract enough coloring matter to give the spectrum of hæmatoporphyrin. In this case, care should be taken not to get any of the fibre of the cloth mixed with the dried blood, since this would be charred by the sulphuric acid, and might obscure the spectrum.

There are several substances, the solutions of which give spectra somewhat resembling those of oxy-hæmoglobin, such as a solution of alkanet root in alum, and one of cochineal, but these substances cannot be reduced so as to give any of the other blood spectra. In a medico-legal case the expert should not be contented with obtaining a single spectrum, but should subject the stain to the action of reagents so as to see several of the blood spectra. There is no substance as yet known which will give all of the spectra which can easily be obtained from a small quantity of dried blood.

As has been mentioned above, all of the foregoing methods of detecting blood, both the chemical and the optical, give us no knowledge as to the kind of animal from which the blood originally came. In order to obtain the information as to whether the blood may or may not be human blood, or have originated from some animal, bird, fish, or reptile, we must resort to the microscopic examination which will now be considered.

MICROSCOPIC EXAMINATION OF BLOOD.

This is by far the most important of our means of determining the nature of suspicious stains, since it not only in many cases enables us to distinguish between certain different kinds of blood, but it may also by revealing the nature of other substances mixed with the blood, in certain cases, enable us to say that the blood is menstrual or that it came from the nose, but this subject will be considered later in studying other stains.

It is never necessary for the expert to give a positive opinion as to the kind of blood. It is his duty simply to give the facts as he finds them; the result of his scientific examination of the substances submitted to him, and to state from his expert knowledge what those facts are consistent with. And if, as in many instances happens, it is claimed by the accused that the blood stains are those resulting from the killing, or the dressing, of some bird, fish, or mammal, such as an ox, pig, or sheep, the expert can state definitely whether or not the corpuscles in the stains examined are consistent with the explanation given.

The distinction between the different kinds of blood depends upon the recognition of the difference in the size and shape of the red corpuscles. This is a comparatively easy matter both with fresh and dried blood, where the distinction to be made depends upon a difference in the shape of the corpuscles, but when the discrimination is to be made between two kinds of blood in which the corpuscles have the same shape, but differ only in size, the problem is much more difficult, especially in the case of dried stains, and it is only possible to make the discrimination in such cases by using the very high powers of the microscope. For this purpose we need a microscope provided with an eye-piece micrometer, a stage or object micrometer, and a first-class objective, giving an amplification of at least fifteen hundred diameters. It is most essential that the stage micrometer should be absolutely accurate, or the value of each division accurately known.

An object micrometer consists of a glass slide upon which are ruled lines exactly $\frac{1}{100}$ of an inch apart: and one of these $\frac{1}{100}$ inch divisions is subdivided into tenths, each of these subdivisions, therefore, representing $\frac{1}{1000}$ of an inch. It often happens that a very slight error occurs in the ruling of these lines, and it is necessary to subject the $\frac{1}{1000}$ inch spaces to careful examination with a high power to ascertain if they are all of equal value; it is best also to compare them with other stage micrometers known to be accurate. Having determined the accuracy of the object micrometer, the value of the eye-piece micrometer can be easily ascertained.

There are several varieties of eye-piece micrometers, the best of which are the cobweb and the Jackson micrometers. The cobweb micrometer consists of two parallel cobwebs, or fine threads, stretched across the field of the eye-piece: one of these is stationary, and the other can be moved away from the fixed one by means of a very delicate screw, the head of which is graduated so that a fraction of a turn may be read by means of an index. The thread of the screw is generally so made that a complete turn of the head will move the movable cobweb $\frac{1}{100}$ of an inch from the fixed one. A scale is also provided consisting of notches in a thin brass plate, each notch corresponding to a single turn of the screw. The object to be measured is moved so that one edge is apparently in contact with the stationary cobweb, then the screw is turned so as to bring the other cobweb in contact with the other edge, when the number of notches will show how many complete turns of the screw have been made, and the index at the head of the screw will show what fraction of a turn has been made in addition; the value of each notch will, of course, vary with the objective used.

The Jackson micrometer is more convenient and is, in our opinion, equally accurate. It has the advantage that it can be introduced into any eye-piece. It consists of a scale, ruled in the ordinary way (with every tenth line long and every fifth line longer than the intermediate ones, but not as long as the tenth line) on a piece of glass which is inserted into a brass frame provided with a screw which presses on one end of the glass slip and a spring pressing against the other end, so that the ruled slip may be moved slightly toward either end, and any given line on the scale be brought in exact juxtaposition with the edge of the object to be measured. The brass frame is passed through narrow slits made in the eye-piece tube just above the diaphragm, and the scale brought into focus by unscrewing the upper lens of the eye-piece.

To ascertain the value of each division of the eye-piece micrometer the standard $\frac{1}{1,000}$ inch object micrometer is brought into the field of vision on the stage. The scale is accurately focussed, one of the long lines on the eye-piece scale brought in exact juxtaposition with one of the lines marking a standard $\frac{1}{1,000}$ inch space on the object micrometer, and the number of divisions on the eye-piece scale exactly covering the $\frac{1}{1,000}$ inch space counted. If, for instance, we find that just eighteen and one-half divisions on the eye-piece cover the $\frac{1}{1,000}$ inch space, each division would represent $\frac{1}{18,500}$ of an inch, which is not a very convenient number for calculation; therefore it is better to withdraw the draw-tube of the microscope until, say, it takes exactly twenty divisions of the eye-piece scale to cover the $\frac{1}{1,000}$ inch space, when each division on the eye-piece micrometer will represent $\frac{1}{20,000}$ of an inch. The exact point to which the draw-tube, which should be graduated, has been withdrawn should be observed and noted. The practiced eye can appreciate a subdivision of each of these eye-piece divisions to one-half, or even to one-quarter, with tolerable accuracy, so that with a micrometry of $\frac{1}{20,000}$ of an inch we can measure a space of $\frac{1}{80,000}$ of an inch with fair accuracy, or with a micrometry of $\frac{1}{25,000}$ of an inch, which can easily be obtained with a fourteenth or sixteenth immersion lens, a space of $\frac{1}{100,000}$ of an inch can be appreciated. Therefore, in measuring a blood globule, if we find that it takes six divisions of the eye-piece scale, with a micrometry of $\frac{1}{20,000}$ of an inch, to exactly cover the blood corpuscle, the diameter of that corpuscle is $\frac{6}{20,000}$ of an inch, which is equal to $\frac{1}{3,333}$ of an inch.

The late Professor Formad brought to his aid photography in the measurement of blood corpuscles. He describes his method of making photo-micrographs representing the blood corpuscles magnified to 10,000 diameters, in a paper read before the College of Physicians at Philadelphia,[1] as follows:

"I first take photo-micrographs of fresh blood (prepared in the usual manner) of man, dog, Guinea pig, ox, sheep, and goat, all executed under the same amplification and projection, and under absolutely similar conditions. Then I have positives prepared from each, and enlarging now single corpuscles of average size, selected from each positive, by rephotographing, I obtained admirable results. In order to get at the comparative size of corpuscles, I selected one human blood corpuscle of $\frac{1}{3,200}$ inch, and enlarged it by photography to the size of three and one-eighth inches, which represents the desired amplification of 10,000 diameters. Any other corpuscle of $\frac{1}{3,200}$ inch will, of course, be three and one-eighth inches under the same projection; but substituting now for that of man the positives of corpuscles of the dog, Guinea pig, ox, sheep, and goat *seriatim*, and of known micrometry, rephotographing each separately, but all under absolutely the same projection, distance, and focus, the striking difference in the size of the corpuscles is quite apparent."

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[1] "Comparative Studies of Mammalian Blood," the Journal of Medicine and Surgery, July, 1888, p. 254.

The photographs which accompany this article differ from those of Professor Formad in being direct photographs and not reproductions, and amplifications of 2,500 and 5,000 diameters have been considered sufficiently large to show the difference in the size of the varieties of mammalian blood selected.

As mentioned above, the discrimination between the different kinds of blood depends on the difference in the shape and size of the red corpuscles. The red corpuscles of all oviparous vertebrates are oval in shape and have a distinct nucleus with the exception of one order of fishes (the *cyclostomata*), in which the corpuscles are circular in form, but with a nucleus as in the case of other fishes. The nucleus is generally oval in shape, but it is sometimes circular, and in birds it is relatively longer and narrower than the corpuscle itself, while in reptiles and fishes it has about the same proportional width and length as the corpuscle. The nucleus in a red blood corpuscle was first discovered by Hewson, and it was long supposed that the red corpuscles of man were also nucleated as well as those of the oviparous vertebrates. The size of the red corpuscles of the oviparous vertebrate is, as a rule, much larger than those of the mammalia, those of the batrachians being the largest, and those of one of the batrachians (the *amphyuma tridactylum*) being large enough to be seen by the unaided eye, $\frac{1}{350}$ of an inch in the long diameter. The red corpuscles of the mammalia are all free from the nucleus except in the embryo, when many of them have a nucleus; they also vary in size within wider limits than after birth, at which time all nucleated corpuscles have disappeared. In shape the mammalian red corpuscles are bi-concave discs with the exception of the *camellidæ* (camel tribe), in which they are oval but without any nucleus, the bi-concavity being plainly perceptible when the edge of the corpuscle is seen, and when lying flat, so that the bi-concave side of the disc is viewed, the bi-concavity is shown by the color, which is paler in the centre and deepens gradually toward the edge, owing to the gradual thickening of the corpuscle from the centre toward the edge. The difference in the refraction caused by the light passing through the different thicknesses of the red corpuscle gives to it the appearance which has sometimes been mistaken for a nucleus. When seen in bulk the red corpuscles have a deep red color, but when a single corpuscle is viewed it is seen to be of a yellow tint. According to Dr. Formad the corpuscles of animals of the highest development have a deeper tint than those of the lower types, the color becoming paler and paler the lower in the animal scale we go, so that the corpuscles are nearly colorless in the *amphyoxis*.

As to the structure of the red corpuscle authorities differ, many considering that it has a distinct cell wall filled with a fluid containing coloring matter. This view was held by many of the older physiologists, as Hewson,[1] Wells,[2] and Schwann,[3] and later by Dr. Richardson,[4] who considers that if they had no cell wall it would be impossible to recognize the corpuscles in a dried clot by any mode of treatment, or in his own words, "The possibility of recognizing blood globules when dried *en masse* is closely associated with, if not actually dependent upon, their possession of a cell wall." On the other hand, others, among whom were Brücke,[5] Rollett,[6] Kollmann, and later Formad,[7] considered that the red corpuscles consist of a cavernous mass, or "stroma," or network, which is colorless, elastic, and of an albuminous nature, the interstices of which are filled with the coloring matter. Dr. Formad considers that what was considered by some to be the cell wall is "only the outer hardened layer of the protoplasm of the corpuscle," since in his experiments upon blood corpuscles with the venom of serpents he has "often seen, under the microscope, red blood corpuscles fused into a colloid mass, which can be stretched and drawn out like molasses candy."[1] This "stroma" theory is more recent, and is, in our opinion, supported by the weight of evidence.

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[1] *Loc. cit.*

[2] "On the Color of the Blood," Phil. Trans., 1797, p. 429.

[3] "Microscop. Researches," Syd. Soc., 1847, p. 67.

[4] "On the Value of High Powers in the Diagnosis of Blood Stains," Amer. Jour. of the Med. Sciences, July, 1874.

[5] "Die Elementärorganismen," Sitzungsber. d. k. Akad. Wien, vol. xliv., Abth. 11, p. 387.

[6] "On Blood," Stricker's Handbook.

[7] *Loc. cit.*

When the red corpuscles are treated with water or any fluid which is less dense than the blood serum, they absorb water and undergo a change of form and size. The circular disc of mammalian blood begins to swell, first losing its bi-concavity and becoming flat, then it becomes bi-convex and finally spherical; with the increase of the bi-convexity the distance between the two edges of the corpuscle lessens, until, when it has become spherical, the diameter has diminished to about two-thirds of its original diameter, and at the same time the density has gradually diminished and the color disappeared; if the action of the water is sufficiently long continued, the outline of the corpuscle appears as a mere line and finally disappears altogether, although sometimes the circular outline may be made visible again by staining with a little solution of anilin red or of iodine. Dr. Formad's measurements of corpuscles which have become spherical by the absorption of water show that the diameter is reduced just about one-third in all the specimens examined, as may be seen in the following table:

	Average Diameter of Spherical Corpuscles.	Average Diameter of Normal Corpuscles.	Normal Diameter Reduced One-third.
Man	1-4300 inch.	1-3200 inch.	1-4267 inch.
Guinea pig	1-4500 "	1-3400 "	1-4533 "
Wolf..........	1-4600 "	1-3450 "	1-4580 "
Dog...........	1-4800 "	1-3580 "	1-4773 "
Rabbit........	1-4900 "	1-3662 "	1-4882 "
Ox............	1-5600 "	1-4200 "	1-5600 "
Sheep.........	1-6700 "	1-5000 "	1-6667 "
Goat..........	1-8100 "	1-6100 "	1-8133 "

Some of the red corpuscles, as is well known by all microscopists who are accustomed to examining blood, resist the action of water and similar reagents much more than others, so that when a blood stain has been subjected to the action of water in small quantities, or for a short time, we may still expect to find some normal corpuscles.

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[1] "Researches upon the Venom of Poisonous Serpents," by S. Weir Mitchell and Edward P. Reichert. Published by the Smithsonian Institution, 1886. Chapter on Pathology by H. F. Formad, p. 133.

I have noticed that this change of the red corpuscle from the normal to the spherical shape is liable to occur in the case of most of the corpuscles in the central portion of a large drop or pool of blood, where several hours elapse before the blood becomes dry. Therefore, in selecting specimens of dried stains for microscopic examination, those parts of the stain should be preferably taken in which the drying has taken place most rapidly, although even in the centre of a large clot we may expect to find some corpuscles of normal shape.

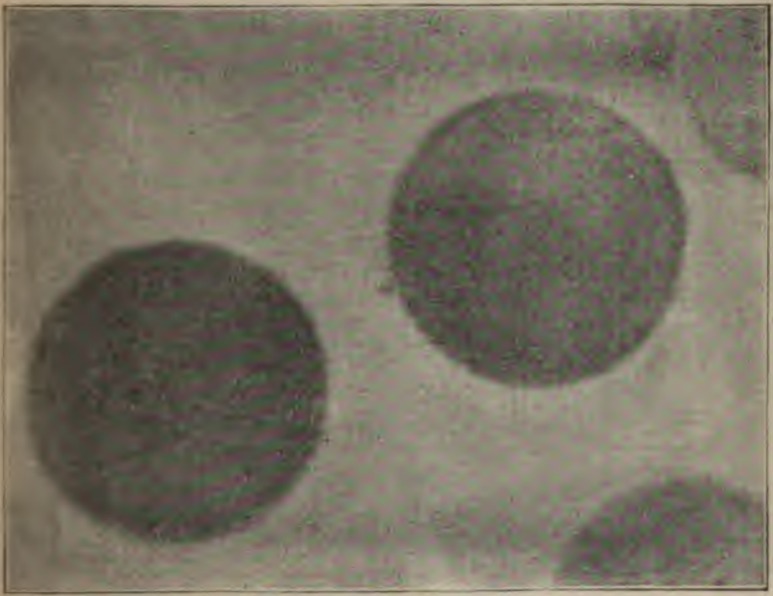

FIG. 8.—Human Blood Corpuscles. × 5,000.

If the red corpuscles are treated with saline solutions of greater density than the blood serum, such as solutions of common salt, sulphate of sodium, and many other compounds, they shrink in size, and the edge becomes crenated and irregular in outline. If the solution has about the same density as the blood serum, the blood corpuscles are only slowly affected. Strongly acid and alkaline solutions, as a rule, quickly destroy the corpuscles, and of the alkalies ammonia is the most active. There is no reagent that we know of at the present time, and no influence outside of the living body which tends to increase the diameter of the red corpuscles. The influence of diseased conditions upon the size of the corpuscle will be referred to later.

Size.—The size of the red corpuscle varies in the different animals very considerably, and, to a slight extent, in the same individual. They are much larger, as a rule, in those animals having nucleated corpuscles than in the mammalia, and are especially large in the batrachians, being, as has been mentioned above, in one of the Louisiana reptiles (*amphyuma*) large enough to be seen with the naked eye, about $\frac{1}{350}$ of an inch. The size of many of these is given in the tables below. Of the mammalia the elephant has the largest red corpuscles, the average size being $\frac{1}{2,745}$ inch, and the musk deer the smallest with an average diameter of $\frac{1}{12,325}$ of an inch (Gulliver). But, as a rule, the average size of the domestic animals varies from $\frac{1}{3,000}$ to $\frac{1}{6,000}$ inch. Authorities differ but slightly as to the

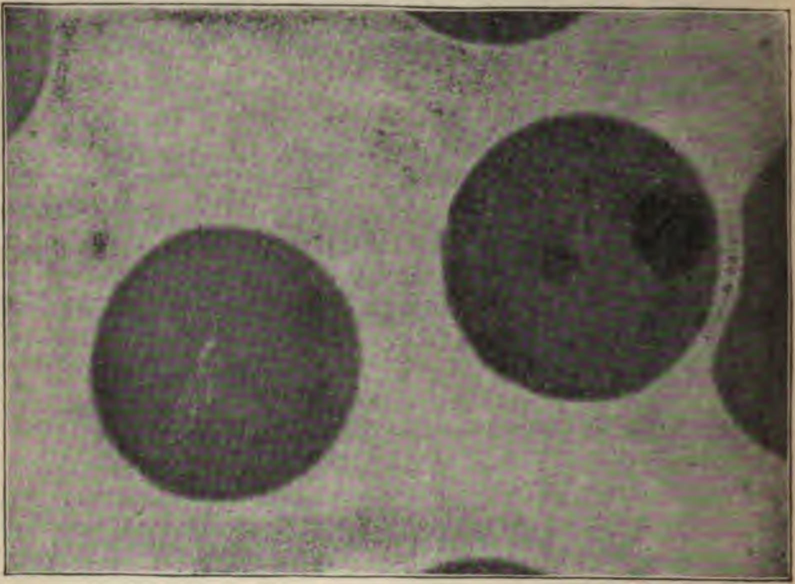

FIG. 9.—Dog Blood Corpuscles. × 5,000.

average measurement of the human red blood corpuscle. All agree that the average diameter is between $\frac{1}{3{,}200}$ and $\frac{1}{3{,}300}$ inch. Gulliver and Formad place the average at $\frac{1}{3{,}200}$ inch, Professor Wormley at $\frac{1}{3{,}250}$ inch, the French Commission appointed by the Medico-Legal Society of France in 1873 at $\frac{1}{3{,}257}$ inch, Masson also at $\frac{1}{3{,}257}$ of an inch. Professor Carl Schmidt[1] in 1848 at $\frac{1}{3{,}300}$ of an inch. Professor Formad, as the result of his measurements, states that 90 per cent of the corpuscles will measure between $\frac{1}{3{,}100}$ and $\frac{1}{3{,}300}$ inch, the maximum measurement being $\frac{1}{2{,}900}$ inch and the minimum being $\frac{1}{3{,}800}$ inch. Not more than 10 per cent, therefore, will fall outside of the normal limit, which he considers from $\frac{1}{3{,}100}$ to $\frac{1}{3{,}300}$ inch.

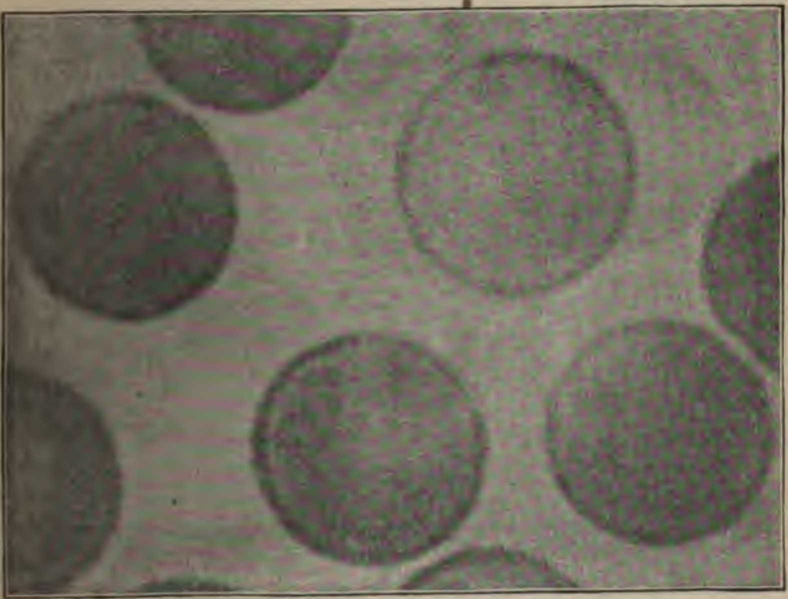

FIG. 10.—Ox Blood Corpuscles. × 5,000.

Professor Wormley found in three series of measurements of five hundred corpuscles each, that of the fifteen hundred corpuscles, only three measured more than $\frac{1}{2{,}857}$ inch and four less than $\frac{1}{3{,}846}$ inch, the average of the first series of five hundred corpuscles being $\frac{1}{3{,}253}$ inch, of the second series $\frac{1}{3{,}242}$ inch, and of the third series $\frac{1}{3,266}$ of an inch, while 77 per cent of the first series, 72.2 per cent in the second, and 81.2 per cent in the third series ranged from $\frac{1}{3,077}$ inch to $\frac{1}{3,389}$ inch. Professor Wormley considers that in the healthy human blood, the corpuscles have a more uniform diameter than is shown in the prepared slides, since the corpuscles may absorb a certain amount of moisture in drying, and thus become slightly swollen so as to lessen the diameter somewhat. Hayem[1] considers that of every one hundred corpuscles not more than twelve corpuscles are larger than the average, nor more than twelve smaller than the average. Professor Carl Schmidt,[2] in 1848, with an amplification of only five hundred diameters, gives as the average diameter of human corpuscles 0.0077 mm. ($\frac{1}{3,300}$ inch), and considers that, even with that low power, discrimination can be made between human blood and that of the domestic animals even in dried stains. There is no doubt, however, that for the certain discrimination between the dif-

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[1] "Die Diagnostik verdächtiger Flecke in Criminalfällen." Mitau u. Leipzig. 1848.

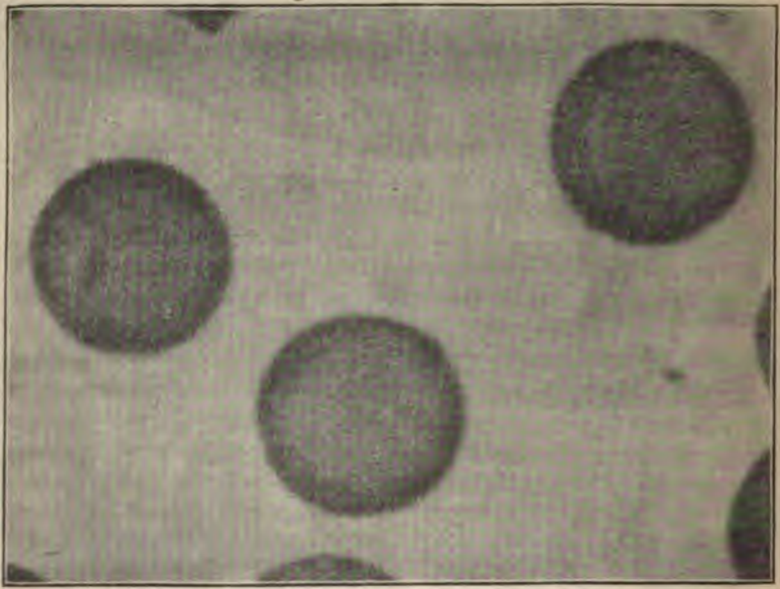

FIG. 11.—Sheep Blood Corpuscles. × 5,000.

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[1] "Du Sang," Paris, 1889.

[2] *Loc. cit.*

ferent kinds of blood, even when fresh, much higher magnifying powers are needed.

The late Prof. Joseph G. Richardson[1] was the pioneer in the use of the high powers in the diagnosis of blood stains. He used $\frac{1}{25}$ and $\frac{1}{50}$ inch immersion objectives, and with the latter lens obtained an amplification of 3,700 diameters, so that a human corpuscle of normal size, when seen with this high power, appeared to measure $1\frac{1}{8}$ inches in diameter, while that of a sheep appeared only $\frac{5}{8}$ of an inch, and that of an ox $\frac{7}{8}$ of an inch in diameter. When magnified to this extent, the difference in the size of the corpuscles of man and the domestic animals, horse, ox, cat, pig, and sheep, is very plainly perceptible.

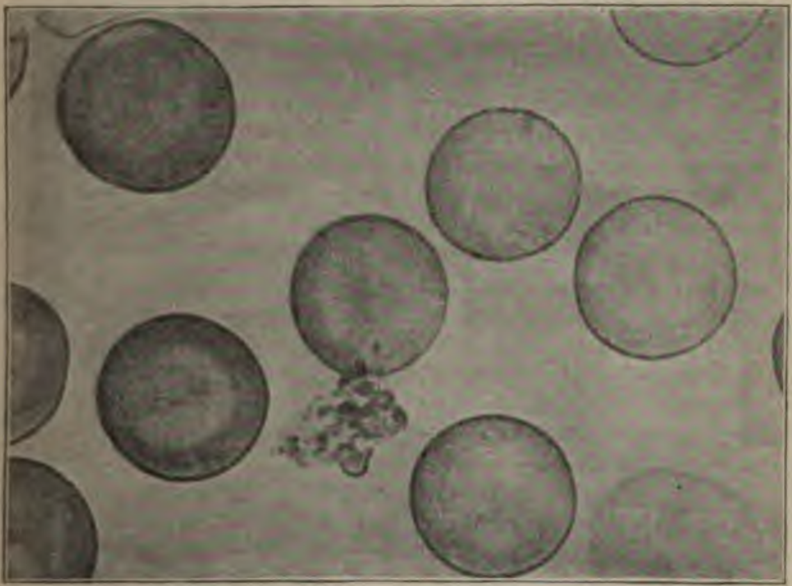

FIG. 12.—Human Blood Corpuscles. × 2,500.

Of the domestic mammals those which are most likely to be considered in medico-legal cases, so far as the discrimination of the kind of blood in a stain is concerned, are the dog, ox or cow, pig, horse, cat, sheep, and goat. As will be seen by the tables below, which give the average diameters of the corpus-

[1] "On the Value of High Powers in the Diagnosis of Blood Stains." The Amer. Jour. of the Medical Sciences, July, 1874.

cles of different animals as obtained by various observers, the corpuscles of the dog approach more nearly those of man than any of the other domestic animals mentioned above. The average diameter of the dog's corpuscle is given as about $\frac{1}{3,550}$ inch (by all except Dr. Woodward,[1] who gives the diameter as $\frac{1}{3,246}$ inch and whose measurements will be referred to presently). The corpuscles of the ox, pig, horse, and cat are less than $\frac{1}{4,000}$ inch, most of the recent measurements giving their size between $\frac{1}{4,200}$ inch and $\frac{1}{4,400}$ inch, although Gulliver and Schmidt of the older observers, who used lower magnifying powers, give the diameters of the corpuscles of the horse somewhat smaller ($\frac{1}{4,600}$ and $\frac{1}{4,555}$ inch), and those of the cat between $\frac{1}{4,400}$ and $\frac{1}{4,600}$ inch. The diameter of the sheep's corpuscle is considerably smaller, about $\frac{1}{5,000}$ inch, and that of the goat, the smallest of all of the domestic animals, being less than $\frac{1}{6,000}$ of an inch.

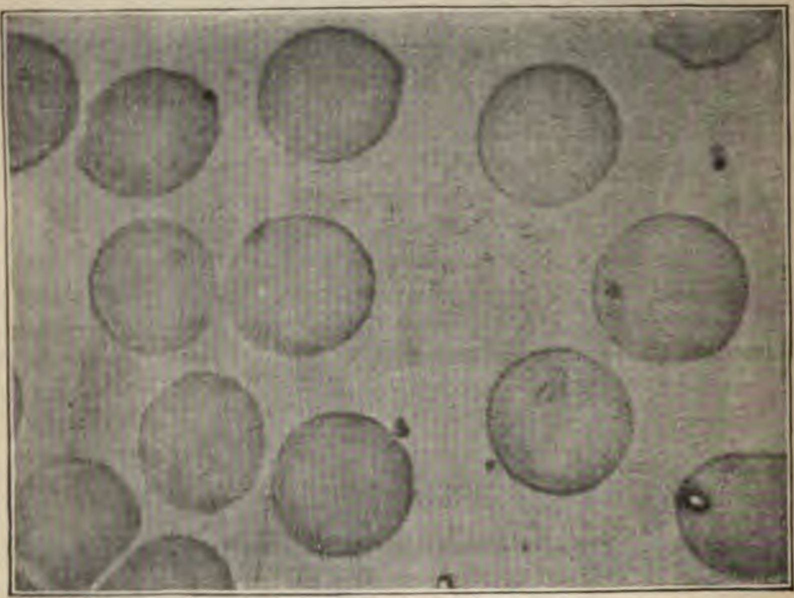

Fig. 13.—Dog Blood Corpuscles. × 2,500.

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[1] "On the Similarity between the Red Blood Corpuscles of Man and those of certain other Mammals, especially the Dog; Considered in Connection with the Diagnosis of Blood Stains in Criminal Cases." Monthly Microscopical Journal of London, 1875.

The diameter of the goat's corpuscle is, therefore, approximately only about one-half that of the human.

Dr. Woodward's average measurements are all larger than those of other observers with the exception of that of the Guinea pig, in which case his average is practically the same as that of Professor Wormley, but in these two series of measurements the species of Guinea pig was different, Professor Wormley's measurements being of the blood of a rare menagerie animal, the *cavia aperea*, while the blood examined by Woodward and the other observers was that of the ordinary Guinea pig, the *cavia cobaya*. All of Dr. Woodward's measurements were made in the same way and with the same scale. It is fair to presume, therefore, since all three of Dr. Woodward's averages are larger than those of the other observers in the same proportion, that his observations are probably to that extent erroneous. My own measurements, so far as the human and the dog corpuscles are concerned, agree practically with those of Professors Wormley and Formad. I have not made any extended series of measurements of the corpuscles of the Guinea pig.

By the method used by Professor Formad, that of rephotographing from the negatives made by photographing normal blood corpuscles, until an amplification of 10,000 diameters is reached, the difference in size of the normal corpuscles will appear as follows:

Human.	1-3200	inch,	will	appear	$3\frac{1}{5}$ inches.
Guinea pig	1-3400	"	"	"	3 "
Dog	1-3500	"	"	"	$2\frac{4}{5}$ "
Ox	1-4200	"	"	"	$2\frac{1}{3}$ "
Sheep	1-5000	"	"	"	2 "
Goat	1-6100	"	"	"	$1\frac{3}{5}$ "

The photographs accompanying this article are representations of the blood corpuscles of man, the dog, ox, and sheep magnified 5,000 and 2,500 diameters respectively. And it will be seen by even the latter amplification that the difference between the human and the dog corpuscles is plainly perceptible. These micro-photographs were taken with a Zeiss' photographic stand using the Zeiss two-millimetre apochromatic oil immersion objective. The amplification was first determined by photographing a standard $\frac{1}{1,000}$ inch space on the object micrometer, so that the lines of the $\frac{1}{1,000}$ inch space were exactly $2\frac{1}{2}$ inches apart in the one case, and five inches apart in the other. The apparatus being perfectly fixed and immovable, the blood corpuscles on the slide were photographed under precisely the same conditions as the stage micrometer. The same remark will apply to the photographs of the restored corpuscles shown later (pp. 62–65).

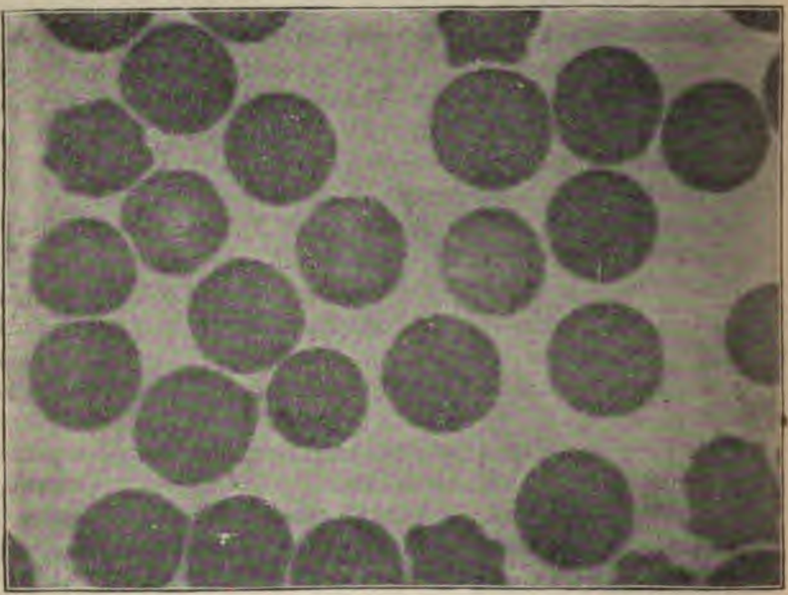

FIG. 14.—Ox Blood Corpuscles. × 2,500.

With these amplifications the apparent size of the corpuscles appears only respectively one-half and one-fourth as large as those of Professor Formad given in the above table, so that in the larger photographs with an amplification of 5,000 diameters, a normal human corpuscle of $\frac{1}{3,200}$ of an inch appears $1\frac{9}{16}$ of an inch in diameter, and that of a dog measuring $\frac{1}{3,500}$ of an inch appears $1\frac{3}{7}$ of an inch in diameter, which is a difference of $\frac{15}{112}$ of an inch, or between $\frac{1}{7}$ and $\frac{1}{8}$ of an inch. Or in the case of the ox, considering the normal corpuscle $\frac{1}{4,200}$ of an inch, when magnified 5,000 diameters, it will appear $1\frac{4}{21}$, or practically $1\frac{1}{5}$, inch in diameter, giving a difference in the apparent size between the human and ox corpuscle of about $\frac{3}{8}$ of an inch (exactly $\frac{125}{336}$ inch).

In the accompanying photographs, Figs. 8, 9, 10, and 11 represent respectively the blood corpuscles of man, the dog, ox, and sheep magnified 5,000 diameters, and Figs. 12, 13, 14, and 15 corpuscles of the same kind magnified 2,500 diameters. I wish here to express my thanks to Mr. H. L. Norton, of the Harvard Medical School, for his valuable assistance in preparing these photographs, and also those of the restored blood corpuscles (see pp. 62–65).

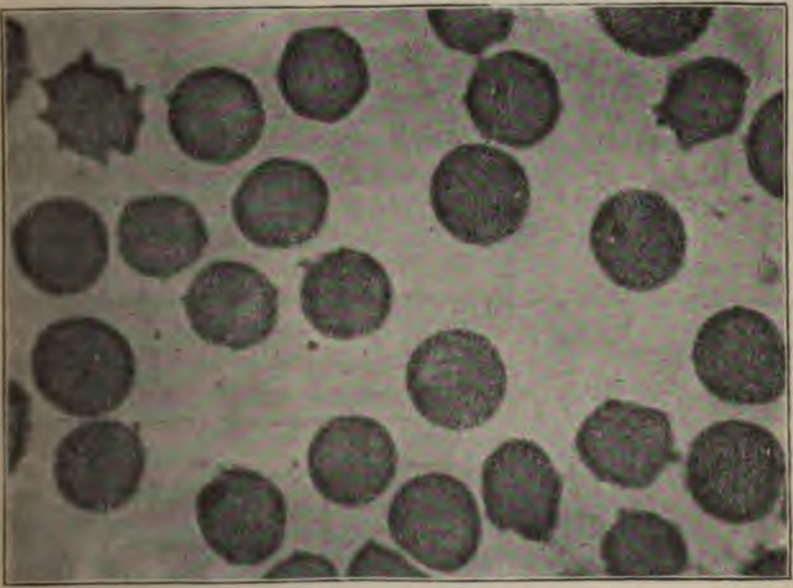

FIG. 15.—Sheep Blood Corpuscles. × 2,500.

The following table gives the measurements of the red corpuscles made by various authorities, including the older ones of Professors Gulliver[1] and Carl Schmidt, who although they used only the lower powers of the microscope, the instruments themselves being by no means as perfect as those of the present day, arrived at results agreeing wonderfully with those of recent workers. Professor Gulliver's measurements were made solely

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[1] "On the Red Corpuscles of the Blood of Vertebrata," Proceedings of the Zool. Soc. of London, 1862.

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AVERAGE SIZE OF THE RED CORPUSCLES.

MAMMALS.	Gulliver.	Wormley.	Formad.	Richardson.	C. Schmidt, 1848.	French Medico-Legal Society, 1873.	Masson, 1885.	Dragendorff.	Woodward.
Man	1–3200	1–3250	1–3200	1–3224	1–3330	1–3386	1–3256	1–3300	1–3092
Monkey	1–3412	1–3382		1–3395					
Opossum	1–3557	1–3145							
Guinea pig	1–3538	1–3223	1–3400				1–3300		1–3213
Kangaroo	1–3440	1–3410							
Musk-rat	1–3550	1–3282							
Dog	1–3532	1–3561	1–3580	1–3542	1–3630	1–3479	1–3577	1–3628	1–3246
Rabbit	1–3607	1–3653	1–3662		1–3968	1–3681	1–3628	1–3968	
Rat	1–3754	1–3652			1–3968				
Mouse	1–3814	1–3743			1–4166				
Pig	1–4230	1–4268	1–4250	1–4230	1–4098	1–4233	1–4098	1–4098	
Ox	1–4267	1–4219	1–4200	1–4267	1–4385	1–4535	1–4233	1–4385	
Horse	1–4600	1–4243	1–4310		1–4456	1–4535			
Cat	1–4404	1–4372			1–4535	1–3907	1–4456	1–4535	
Elk	1–3938	1–4384							
Buffalo	1–4586	1–4351							
Wolf (prairie)	1–3600	1–3422	1–3450						
Bear (black)	1–3693	1–3656							
Hyena	1–3735	1–3644							
Squirrel (red)	1–4000	1–4140							
Raccoon	1–3950	1–4084							
Elephant	1–2745	1–2738							
Leopard	1–4319	1–4390							
Hippopotamus	1–3429	1–3560							
Rhinoceros	1–3765	1–3649							
Whale	1–3099			1–3090					
Tapir	1–4000	1–4175							
Lion	1–4322	1–4143							
Ocelot	1–4220	1–3885							
Mule		1–3760							
Ass	1–4000	1–3620							
Ground squirrel		1–4200							
Bat	1–4175	1–3966							
Sheep	1–5300	1–4912	1–5000	1–5300	1–5649	1–5080		1–5649	

AVERAGE SIZE OF THE RED CORPUSCLES.—*Continued.*

MAMMALS.		Gulliver.	Wormley.	Formad.
Ibex			1-6445	
Goat		1-6366	1-6189	1-6100
Sloth		1-2865		
Platypus (duck-billed)		1-3000		
Capybara		1-3190	1-3164	
Seal		1-3281		
Woodchuck		1-3484		
Musk-deer		1-12325		
Beaver		1-3325		
Porcupine		1-3369		
Llama	long diam	1-3361	1-3201	
	short "	1-6299	1-6408	
Camel	long "	1-3123	1-3331	
	short "	1-5876	1-5280	
BIRDS.				
Chicken	long diam	1-2102	1-2080	
	short "	1-3436	1-3483	
Turkey	long "	1-2045	1-1894	
	short "	1-3598	1-3444	
Duck	long "	1-1937	1-1955	
	short "	1-3424	1-3504	
Pigeon	long "	1-1973	1-1892	
	short "	1-3643	1-3804	
Goose	long "	1-1836		
	short "	1-3839		
Quail	long "	1-2347		
	short "	1-3470		
Dove	long "	1-2005		
	short "	1-3369		
Sparrow	long "	1-2140		
	short "	1-3500		
Owl	long "	1-1763		
	short "	1-4076		

REPTILES.		Gulliver.	Wormley.
Tortoise (land)	long diam	1-1252	1-1250
	short "	1-2216	1-2200
Turtle (green)	long "	1-1231	
	short "	1-1882	
Boa-constrictor	long "	1-1440	1-1245
	short "	1-2400	1-2538
Viper	long "	1-1274	
	short "	1-1800	
Lizard	long "	1-1555	
	short "	1-2743	
BATRACHIANS.			
Frog	long diam	1-1108	1-1089
	short "	1-1821	1-1801
Toad	long "	1-1043	
	short "	1-2000	
Triton	long "	1-848	
	short "	1-1280	
Proteus	long "	1-400	
	short "	1-727	
Amphiuma tridactylum	long "	1-363	1-358
	short "	1-615	1-622
FISHES.			
Trout	long diam	1-1524	
	short "	1-2460	
Perch	long "	1-2099	
	short "	1-2824	
Pike	long "	1-2000	
	short "	1-3555	
Eel	long "	1-1745	
	short "	1-2842	
Lamprey (circular)		1-2134	
" (diam. of nucleus)		1-6400	

with a view of obtaining some means of classification of the different animals, and not with any medico-legal interest. These measurements are given only in vulgar fractions of an inch, as that is the method in almost universal use in this country. Where the original figures were in one-thousandths of a millimetre, I have converted them into fractions of an inch.

The first two columns of the preceding table are taken from the Appendix to the second edition of Professor Wormley's "Micro-Chemistry of Poisons," p. 733 *et seq.*

The comparative size of the red corpuscles is well shown in the plate of Professor Gulliver's, which I reproduce together with the explanation of the plate taken from Professor Formad's article upon "The Comparative Studies of Mammalian Blood."

Professor Gulliver does not claim for his table absolute accuracy, but says that "the relative value of the measurements, though probably not unexceptionable, may be entitled to more confidence as fair approximation to the truth."

Explanation of the Figures upon Gulliver's Plate.—All the objects are red blood corpuscles done to one and the same scale, which is at the foot of the drawing. The whole length of the scale represents $\frac{1}{1,000}$ of an English inch, and each one of the ten divisions $\frac{1}{10,000}$ of an inch. Only corpuscles of the average sizes and quite regular shapes are given; and they are all magnified to the same, to wit, about 800 diameters. For details see description below.[1]

A.—VERTEBRATA APYRENÆMATA (SEE PLATE).

I. HOMO (MAN)	1–3,200
[2] 1. Corpuscles lying flat.	
2. The same on edge.	
3. Membranous base of same after removal by water of coloring matter; it shows diminution in diameter on account of acquired spherical shape.	
II. QUADRUMANA (MONKEYS).	
4. Simia troglodytes (chimpanzee)	1–3,412
5. Ateles ater (black-faced spider monkey)	1–3,602
6. Lemur anguanensis	1–4,003
III. CHEIROPETERA (BATS).	
7. Cynoncteris collaris (fruit bat)	1–3,880
8. Vespertilio noctula (large bat)	1–4,404
9. Vespertilio pipistrellus (common bat)	1–4,324

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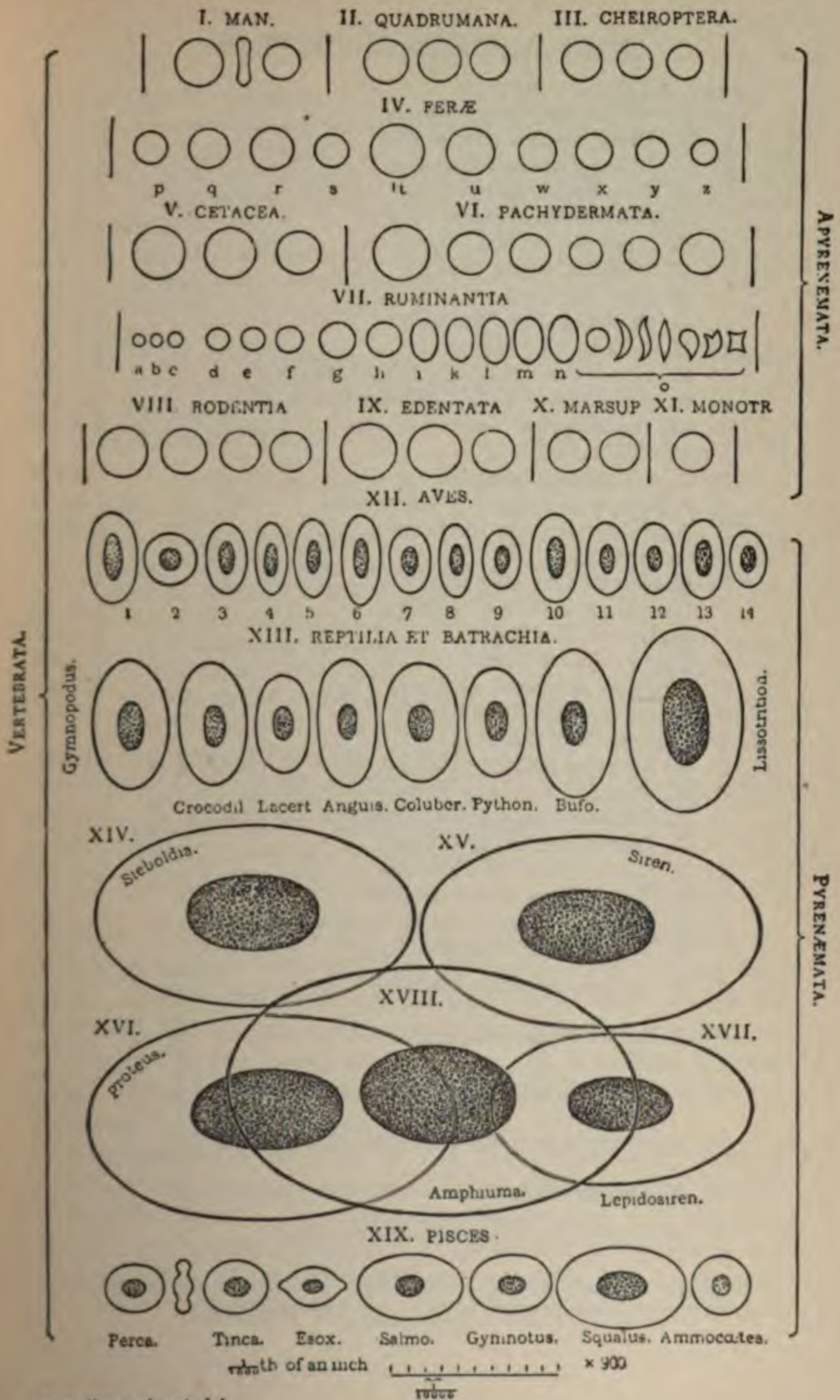
[1] It seems to be 900.—H. F. F.

[2] Through an oversight, some of the figures are not marked upon the plate.

Gulliver's micrometry of red blood corpuscles, all to a uniform scale.



G. Gulliver ad. nat. del.

FIG. 16.

IV. FERÆ (BEASTS OF PREY).		
(p) 10. Sorex tetragonurus (shrew)		1–4,571
(q) 11. Ursus labiatus (lipped bear)		1–3,728
(r) 12. Bassaris astuta (civet cat)		1–4,033
(s) 13. Cercoleptus caudivolvulus (kinkajou)		1–4,573
(t) 14. Trichechus rosmarus (walrus)		1–2,769
(u) 15. Canis dingo (dog, Australian)		1–3,395
(w) 16. Mustella zorilla (weasel)		1–4,270
(a) 16. Felis leo (lion)		1–4,322
(b) 16. Felis leopardus (leopard)		1–4,319
(z) 17. Felis tigris (tiger)		1–4,206
(y) 18. Paradoxurus pallasii (Pallas paradoxure)		1–5,485
(x) 19. Paradoxurus bondar (Bondar paradoxure)		1–5,693
(a) 19. Hyena striata (striped hyena)		1–3,735
V. CETACEA (WHALES).		
20. Balæna (boops—whale)		1–3,099
21. Delphinus globiceps (ca'ing-whale)		1–3,200
22. Delphinus phocæna (porpoise)		1–3,829
VI. PACHYDERMATA.		
23. Elephas indicus (elephant)		1–2,745
24. Rhinoceros indicus (rhinoceros)		1–3,765
25. Tapirus indicus (tapir)		1–4,000
26. Equus caballus (horse)		1–4,600
27. Dicotyles torquatus (peccary)		1–4,490
28. Hyxar capensis (Cape hyrax)		1–3,308
VII. RUMINANTIA (RUMINANTS).		
(a) 29. Tragulus javanicus (Javan chevrotain, musk-deer)		1–12,325
(b) 30. Tragulus meminna (Indian chevrotain)		1–12,325
(c) 31. Tragulus Stanleyanus (Stanleyan chevrotain)		1–10,825
(d) 32. Cervus nemorivagus (deer)		1–7,060
(e) 33. Capra Caucasica (Caucasian ibex)		1–7,045
(f) 34. Capra hircus (domestic goat)		1–6,366
(g) 35. Bos urus (represented by Chillingham cattle)		1–4,267
(h) 36. Camelopardalis giraffa (giraffe)		1–4,571
(i) 37. Auchenia vicugna (vicuna)	L. D.	1–3,555
	Sh. D.	1–6,587
(k) 38. Auchenia paca (alpaca)	L. D.	1–3,361
	Sh. D.	1–6,229
(l) 39. Auchenia glama (llama)	L. D.	1–3,361
	Sh. D.	1–6,229
(m) 40. Camelus dromedarius (single-hump camel)	L. D.	1–3,254
	Sh. D.	1–6,931
(n) 41. Camelus Bactrianus (double-hump camel)	L. D.	1–3,123
	Sh. D.	1–5,876
(o) 42. Cervus Mexicanus[1] (deer—Mexican)		1–5,175

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[1] The only animal in which the red blood corpuscles present a variety of shapes in the same individual.—GULLIVER.

VIII. Rodentia (Rodents).	
43. Hydrochœrus capybara (capybara)	1–3,190
44. Castor fiber (beaver)	1–3,325
45. Sciurus cinereus (squirrel)	1–4,000
46. Mus messorius (harvest mouse)	1–4,268
IX. Edentata.	
47. Myrmecophaba jubata (ant-eater)	1–2,769
48. Bradypus didactylus (sloth)	1–2,865
49. Dasypus villa (armadillo)	1–3,315
X. Marsupialia.	
50. Phascolomys (wombat)	1–3,456
51. Hypsiprymnus setosus (kangaroo rat)	1–4,000
XI. Monotremata.	
52. Echidna histrix (echidna)	1–3,840

B.—VERTEBRATA PYRENÆMATA.

XII. Aves (Birds).	L.D.	Sh.D.
1. Struthio camelus (ostrich)	1–1,649	1–3,000
2. The same made round and deprived of color by water.		
3. Vanga destructor (East India shrike)	1–2,019	1–3,892
4. Lanius excubitor (great gray shrike)	1–1,989	1–5,325
5. Bubo virginianus (horned owl)	1–1,837	1–4,000
6. Syrnea nyctea (snowy owl)	1–1,555	1–4,042
7. Columba rufina (rufous pigeon)	1–2,314	1–3,329
8. Columba migratoria (wild pigeon)	1–1,909	1–4,626
9. Dolichonyx oryzivorus (rice bird)	1–2,400	1–4,167
10. Buceros rhinoceros (rhinoceros hornbill)	1–1,690	1–3,230
11. Psittacus augustus (August amazon)	1–2,085	1–3,606
12. Phasianus superbus (barrel-tailed pheasant)	1–2,128	1–3,587
13. Pelecanus onocrotalus (white pelican)	1-1,777	1–3,369
14. Trochilus sp. (humming bird)	1–2,560	1–4,000

Figs. XII., XIV., XVI., XVII. and XVIII. represent red blood corpuscles of Reptilia and Batrachia: while under Fig. XIX., those of the fishes are given. In all these figures the names of the animals are inserted upon the plate, and they do not require any comment at this place. It is evident that the blood corpuscles of the amphiuma are so large that they can be perceived by the naked eye.

The **quantity** of blood in the body necessarily varies at different times in the same individual within narrow limits. In man the quantity has been estimated at about $\frac{1}{13}$ of the total weight of the body (Bischoff[1]). In the dog the quantity has been variously estimated by different physiologists as from $\frac{1}{11}$

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[1] Zeitsch. f. wiss. Zoologie., Bd. vii., 1854.

to $\frac{1}{18}$, the majority of physiologists giving the proportion as from $\frac{1}{11}$ to $\frac{1}{12}$ of the body weight. In the cat from $\frac{1}{10}$ to $\frac{1}{12}$. In the rabbit from $\frac{1}{12}$ to $\frac{1}{13}$. In the Guinea pig about $\frac{1}{12}$ (Steinberg[1]).

According to Dana, the quantity of blood is less in most of the domestic animals than in man and the dog, namely: in the cat $\frac{1}{14}$; in the horse $\frac{1}{15}$; in the rabbit $\frac{1}{18}$; in the Guinea pig $\frac{1}{19}$; in the calf $\frac{1}{21}$; in the sheep $\frac{1}{24}$; in the pig $\frac{1}{26}$; and in the ox $\frac{1}{29}$ (Formad[2]).

METHOD OF EXAMINATION.

In order to obtain measurements of fresh blood corpuscles, a small drop may be placed upon a perfectly clean glass slide, and covered with a thin covering-glass, which should be surrounded with a rim of paraffin, oil, or some kind of cement to prevent the evaporation of any of the water. If too much blood has not been taken and the slide and cover be perfectly clean, a thin layer of blood will be obtained showing most of the corpuscles lying flat, so that they can be easily measured, and not in rouleaux, in which form the corpuscles would arrange themselves if the drop of blood under the cover were too large. The slide may then be placed under the microscope, and those corpuscles which are perfectly normal in shape be measured.

A more convenient method, and the one almost universally adopted, is to measure the corpuscles after drying the blood on a glass slide or covering-glass in a very thin layer. This may be done by placing a very small drop of blood on the edge at the end of a ground-glass slide, and drawing this edge quickly over the surface of another slide or of a covering-glass, when a very thin layer of blood, which will dry quickly, will be left on the surface. In many places it will be so thin that the corpuscles will be found isolated and lying on their sides so that they may be measured readily. Many of the corpuscles, however, will be found to be more or less distorted, and only those which are perfectly round should be selected for measurement.

A better preparation, one containing a much larger proportion of perfect corpuscles, will be obtained if precautions are taken which physicians and pathologists nowadays take in preparing very thin layers of blood for the Ehrlich's method of examining blood for clinical purposes. These precautions consist chiefly in insuring the perfect cleanliness of the glasses; only very thin covers are used, and, since the slightest contamination upon the surface of the cover, such as would be obtained from contact with the fingers, would spoil the preparation, they should only be handled with delicate forceps. The covers are washed with alcohol immediately before being used. After being wiped carefully so that it is perfectly clean, one of the covering-glasses is brought in contact with a drop of fresh blood drawn from the finger or ear, and allowed to fall immediately upon the other cover, when, if the glass surfaces were perfectly clean, the blood will spread out between the two at once; then the upper one should be immediately withdrawn from the lower, carefully and quickly, taking care not to change the plane of the two glasses. A very thin layer of blood will thus be left on both covers which will dry almost immediately. The drying may be hastened by warming gently over a flame. When skilfully prepared in this way, most of the red corpuscles are seen isolated and of perfect shape, without crenation or distortion. When a thin layer of fresh blood is thus prepared, the red corpuscles are very slightly flattened and their diameters, consequently, very slightly increased. But this increase is scarcely appreciable even with the very high powers of the microscope, and in no way does it interfere with the discrimination between the different kinds of mammalian blood. The corpuscles thus dried in thin layer may be mounted, while dry, on a slide, or, if it is desired, they may be fixed by heating them to 120° C. for an hour, be mounted in any desired fluid, and the measurement of the perfect corpuscles made at some convenient time.

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[1] Arch. für die gesammt. Physiol., Bd. vii., p. 101.

[2] *Loc. cit.*, p. 258.

The method of preparing dried blood for microscopic examination and measurement of the red corpuscles is very different. In order to bring out the corpuscles in dried blood into such a condition that they may be recognized by their normal shape, and into such a position as to free them from surrounding masses so that their edges may be properly focussed and measured, it is necessary to treat a particle of the dried blood with some menstruum which will soften the mass and allow the corpuscles to separate. This menstruum should not be of such a nature as to destroy the corpuscles or to alter their shape, if the object is to obtain corpuscles of normal size for measurement. If the only object be to ascertain whether or not blood corpuscles are present, almost any menstruum may be used which will not rapidly destroy them.

Various menstrua have been recommended for this purpose, most of them being of about the same specific gravity as the blood serum. Some hæmatologists prefer alkaline and some acid menstrua, while others use neutral solutions. Those which are more or less alkaline disintegrate the dried masses more quickly than the others. The principal menstrua which have been recommended are the following:

Virchow's Liquid.—A solution of caustic potash of 30 or 33 per cent.

Roussin's Liquid.—Glycerin, 3 parts; sulphuric acid, 1 part; and enough water to render the liquid of a specific gravity of 1,028.

Ranvier's Iodized Serum.—Iodide of potassium, 2 grams; water, 100 grams; and iodine in sufficient quantity to saturate the solution.

Vibert's Liquid.—Corrosive sublimate, ½ part; common salt, 2 parts; and water, 100 parts.

Paccini's Liquid.—Water, 300; glycerin, 100; common salt, 2; and corrosive sublimate, 1 part.

Melassez and Potain's Liquid.—Equal parts of a solution of gum arabic, sulphate of sodium, and common salt, each solution having a specific gravity of 1,020.

A solution of sulphate of sodium which contains five or six per cent of the salt has also been used.

Dr. Joseph G. Richardson used a three-fourths per cent solution of common salt, first washing out most of the coloring matter with the dilute salt solution, and then staining the corpuscles with anilin red.

Welcker used a solution of glycerin in water, 1 part to 7, and also an artificial serum consisting of common salt 4 parts, egg albumen 300 parts, and water 2,700 parts. Solutions of arsenic and of bichromate of potassium have also been used for this purpose, and the writer frequently employs a solution of the acetate of potassium of a specific gravity of 1,030 with very satisfactory results.

Professor Wormley recommends simply distilled water used in quantities not to exceed that originally present in the dried blood mass examined. He also sometimes uses a solution of glycerin of a specific gravity of 1,030, which does not evaporate as readily as water alone, and when treating a very old stain which disintegrates slowly, he recommends the addition of a little caustic potash to the water or the dilute glycerin.

Müller's fluid consists of the bichromate of potassium, 2 parts; sulphate of sodium, 1 part; and water, 100 parts.

In selecting portions of a dried blood stain for microscopic examination and the measurement of the corpuscles, small particles of dried clot should be obtained if possible. These should be taken from parts of the stain where the blood has dried quickly, since if a mass of blood is several hours in drying, most of the red corpuscles absorb water and become of abnormal shape and reduced diameter. One or more of these minute particles may be removed from the surface to which it adheres with the point of a knife-blade and transferred to a glass slide. If the fragments are too large, they may be gently crushed with the blade of the knife. A small drop of one of the above fluids may then be placed on the slide so as to cover the particles of dried blood and the whole covered with a thin covering-glass. The dried blood mass will, after a longer or shorter time, according to the age of the stain, become softened so that red corpuscles may be seen of normal size and shape. The slide should be examined, from time to time, with a low power, one-fourth or one-fifth inch objective, and when corpuscles suitable for measurement are seen they may be examined and measured with the high power. Distorted and swollen corpuscles should not be measured, but only these which are seen to be of normal shape.

If the blood has fallen upon a non-absorbent surface, a thin dried crust is suitable for the microscopic examination. If the blood falls upon a piece of cotton or linen cloth, into the fibres of which it is immediately absorbed, it is almost impossible, even although it dries quickly, to obtain from the dried stain normal blood corpuscles, unless a small coagulum or crust can be found containing corpuscles which are not closely adherent to the fibres of the cloth. Any condition which prevents the corpuscles from soaking into the meshes of the cloth, as in the case of starched linen, increases the chance of finding normal corpuscles suitable for measurement. The examination of blood-stained cotton or linen fibre shows the blood corpuscles distorted and contracted, so that only here and there one can be seen suitable for measurement. This is probably due to the fact that the fibres are easily moistened, and by virtue of the capillary attraction the blood corpuscles penetrate the interstices between the smallest filaments and become closely adherent to these filaments, forming a coating over them. The filaments are swollen by the moisture and on drying contract, causing the corpuscles which tightly adhere to them to contract also and to become distorted, so that it is impossible to restore them by any of the above liquids to their normal size and shape. In such cases, therefore, the expert must consider it very doubtful whether success attends his efforts or not. In the case of nucleated corpuscles, however, the nuclei can be distinguished, so that in the case of dried stains of this kind we are almost always able to discriminate between the blood of mammals and that of oviparous animals. If by chance, however, we can find a minute crust of dried coagulum, we may expect to find a sufficient number of normal corpuscles to enable us to obtain a satisfactory average measurement.

When blood falls upon a surface of wool, felt, or hair, which is not easily moistened, the blood does not penetrate the fabric immediately, so that after drying one can always find larger or smaller crusts of dried coagula which on proper treatment readily yield a sufficient number of normal corpuscles suitable for measurement.

On examining dried blood with any of the menstrua mentioned above, it will be found that in some cases the normal corpuscles can be seen very soon, while in others the dried blood must be allowed to macerate for several days. As a rule, the older the stain the longer will it take to disintegrate. When the blood has been dried only a few days, the clot disintegrates readily, and the normal corpuscles may be seen in the course of from a few minutes to a few hours after being treated with the restoring fluid.

Professor Formad, who prefers Virchow's or Müller's fluid, recommends in the case of very old stains that the slide be subjected to the action of gentle heat for several days under conditions which will prevent the evaporation of any of the water. In old stains it sometimes happens that only a comparatively few of the corpuscles will appear normal so as to be suitable for measurement, most of them appearing distorted or contracted. As a rule, however, a sufficient number can be measured to obtain a satisfactory average, even in stains several years old.

Blood which has dried upon a non-absorbent surface like glass, wood, etc., if it has not been subjected to the action of the weather, particularly of moisture, for a long time, affords satisfactory material for examination. Blood dried on an iron surface, as in the case of knife-blades and iron implements, such as axes or hatchets, gives perfectly satisfactory results if the substance has been kept in a dry place, so that rusting of the iron has not taken place. If, however, it has been subjected to the action of moisture, the rusting of the iron and the moisture may cause the corpuscle to become abnormal or even completely destroyed, and the rusting of the iron may also decompose the hæmoglobin.

If an effort has been made to remove the stain from clothing by washing, as not infrequently happens in criminal cases, the corpuscles may or may not be destroyed, according to the thoroughness of the washing. Prolonged soaking or a thorough washing with cold water will, of course, remove all traces of the blood from blood-stained material, but attempts at hastily removing blood stains from clothing by washing or wiping are frequently unsuccessful, since partially dried blood is by no means easily removed, especially from a rough surface. On cloth a hasty washing or wiping changes the appearance of the stain, particularly on white cloth, so that it looks diffused, and after the cloth has become dry it will be seen that the red coloring matter has been carried by the water to a distance from the blood spot and left on the cloth in the form of a light-brown or reddish-brown diffused stain. Sea-water removes blood from cloth or other material much less readily than fresh water. In fact, it is the prevailing opinion among sailors that salt water *sets* the blood, on account of the difficulty they experience in attempting to wash dried fish-blood from their boats. Experiments made by me in connection with the Egg Island (near

New Bedford) murder, in 1892, showed that thoroughly dried blood stains on cloth and wood were completely removed by prolonged immersion in salt water, but it required several hours longer than in fresh water. If dried blood be subjected to the action of water or moisture for a sufficiently long time for every portion of the mass to be affected, the corpuscles will absorb more or less of the water and become so changed that no subsequent treatment will restore them to their normal shape and size, and they may be destroyed altogether.

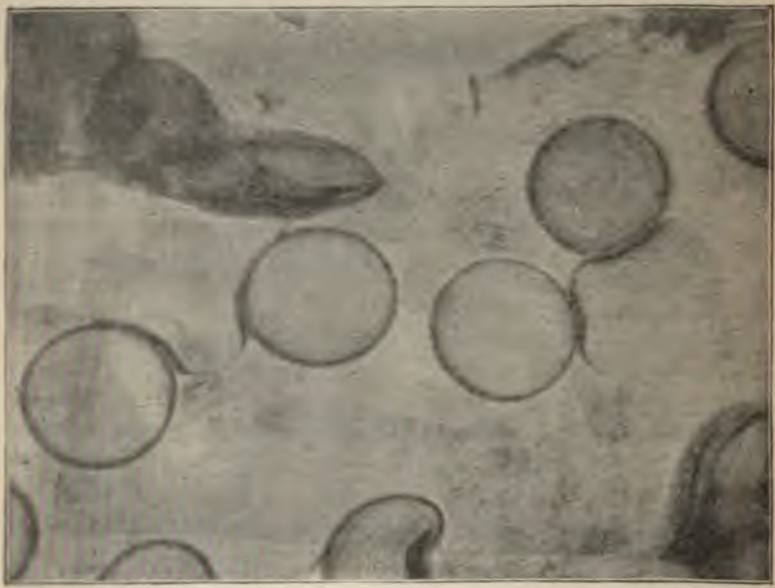

FIG. 17.—Corpuscles from a Human Blood Stain Dried on Paper, Sixteen and a Half Weeks Old. × 2,500.

In the examination of blood-stained clothing or other articles it is essential for the examiner to note the exact appearance and location of every stain, observing particularly its exact shape, which may throw light as to the direction from which the blood came (see page 12), and if the stain is upon cloth, so that it has penetrated through the whole thickness, he should observe and note upon which side the stain is larger and more plainly perceptible, as showing with which side of the cloth the blood first came in contact. He should note also the appearance, just referred to, caused by the application of water or a wet cloth, which dissolves some of the color, causing it to spread from the blood spot, and giving the appearance of a diffused stain.

Wiping a fresh blood spot hastily with a wet cloth changes its appearance when dry from that of a dried blood spot or spatter to that of a smooch, which on woollen cloth, like that of a coat or rough overcoat, may be seen upon examination with a magnifying-glass to contain numerous small, shining particles of dried blood, some of which cling to the end of the woollen fibres very tenaciously.

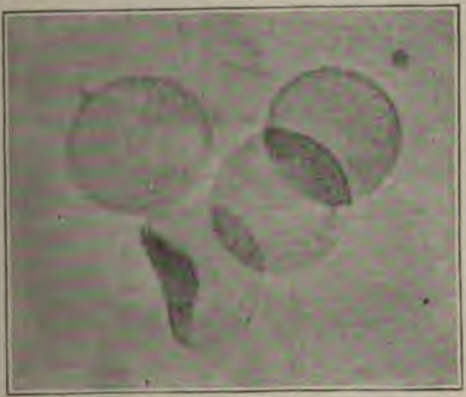

FIG. 18.—Corpuscles from Dog Blood Stain on Wood, Three Weeks Old. × 2,500.

In the examination of the stains with the microscope the examiner should also note carefully the presence with the blood corpuscles of any substance foreign to the blood, such as mucus, epithelial cells of various kinds, minute fibres of cotton, silk, wool, or hemp, minute bits of wood shavings, vegetable cells or fibres, pieces of animal tissues, such as particles of hair, muscular fibre, bone, fat, or feathers, since the presence of these substances may throw some light upon the origin of the blood with which they are mixed. For instance, I have known of several cases in which the admixture of the blood with muscular and adipose tissue proved of great value in deciding as to the origin of the blood in the spot. In one case a chip of wood containing what was supposed to be a blood stain was unofficially brought to me for examination. This proved to be a minute fragment of bone with the muscular attachment, and only a very few blood corpuscles.[1]

In case the dried blood has been treated with water to a sufficient extent to cause the corpuscles to become swollen, they can still be recognized, according to Formad, since the diameter of the red corpuscle when swollen is diminished in the same proportion in every animal, so that there is a normal standard average for the swollen, spherical red corpuscle of every animal, as well as for the perfect bi-concave corpuscle (see table, p. 40).

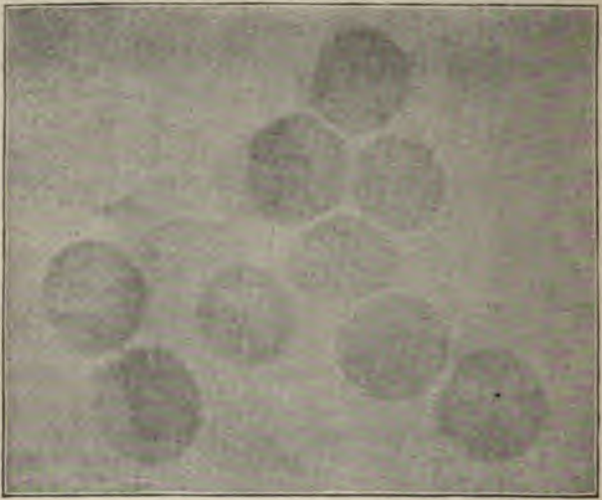

FIG. 19.—Corpuscles from Ox Blood Stain on Wood, Three Weeks Old. × 2,500.

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[1] In this case, had the result of my examination been known in season, it might have resulted in a change of the verdict from one of acquittal to one of conviction, since the stains obtained from the same locality were pronounced by other examiners to be blood stains, the corpuscles of which were consistent with their being human blood stains. However, as the shrewd counsel for the defendant, who alleged that they were stains of horse's blood caused by his having bled a horse there, succeeded in throwing a doubt in the minds of the jury as to the possibility of discriminating between the blood of man and that of the horse by microscopic examination, and as my examination was not made in time for the result to be introduced in the direct evidence, and was not offered until the rebutting testimony was being presented, it was excluded by the court on the ground that it was a new kind of evidence, and should have been presented in the early part of the case. The fact was that the body of the murdered man was mutilated in that place, both legs having been chopped off with an axe, which accounted for the presence of the bone splinter with the muscular attachment in the spot which I examined.

The accompanying photographs of blood corpuscles from dried stains show that corpuscles perfect in shape and size *can* be obtained from dried blood, and that the discrimination between the different kinds of blood corpuscles can be made, providing the blood has dried properly, as positively as from fresh blood.

In these photographs the amplification is in all 2,500 diameters. Fig. 17 represents the human blood corpuscles from a dried stain sixteen and one-half weeks old. It was a stain on a paper book-cover. Fig. 18 shows the corpuscles from a dog's blood stain three weeks old on a piece of wood. Fig. 19 corpuscles from an ox blood stain on wood three weeks old. Fig. 20 those from a sheep's blood stain on a piece of carpet ten weeks old. It is extremely difficult in a dried blood stain treated with a restoring fluid to find any considerable number of normal corpuscles in the same plane so that they can be photographed satisfactorily, although many can be found suitable for measurement.

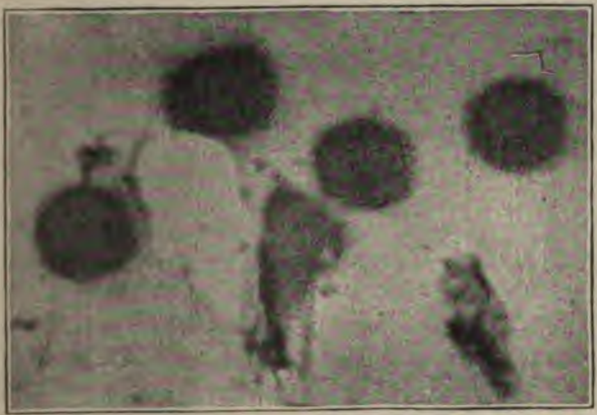

FIG. 20.—Corpuscles from Sheep Blood Stain on Carpet, Ten Weeks Old. × 2,500.

The following tables taken from Professor Formad's article[1] and Professor Wormley's[2] give the results of the measurement of red corpuscles of different kinds taken from dried blood, the origin of the blood in many of the cases being unknown to the examiner.

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[1] *Loc. cit.*, p. 295.

[2] *Loc. cit.*, p. 738.

TABLE OF PROFESSOR H. F. FORMAD'S MEASUREMENTS.

COLLECTIVE RESULTS OF SOME OF THE SERIES OF MEASUREMENTS OF RED BLOOD CORPUSCLES IN BLOOD STAINS AND IN EXPERIMENTALLY DRIED BLOOD.

Normally shaped (bi concave, disk-like) corpuscles only being measured.

Source of Blood.	Upon what Substance.	Age of Stain.	Condition, or how Prepared.	Number of Individuals Examined.	Number of Preparations Made.	Reagents used for Remoistening.	Time of Effect of Reagents.	Per Cent of Measurable Corpuscles in each Preparation.	Total Number of Corpuscles measured.	Average Diameter in inch.	Normal Diameter of Fresh Blood.
Man	Knife and glass..	2 days..	Rapidly dried	10	20	[1]K.O.H.	5 to 30 min.	20 to 50	1000	1-3250	1-3200
Man	Cloth	7 days..	Slowly dried..................	2	10	K.O.H.	½ hour to 2 days	5 to 20	250	1-3300	1-3200
Man	Wood and linen.	10 days.	Slowly dried..................	4	20	[2]M.F.	2 hrs. to 2 days.	5 to 15	200	1-3300	1-3200
Man	Paper...........	14 days.	Decomposed from moisture ...	1	10	M.F.	3 days.	not	mea	sura	ble.
Man	Knife............	2 years.	Well dry preserved...........	1	10	K.O.H. & M.F.	2 days.	10 to 50	400	1-3240	1-3200
Man	Stone	6 years.	Well preserved................	1	30	K.O.H. & M.F.	3 days.	5 to 20	500	1-3320	1-3200
Guinea-pig...	Glass............	7 days..	Rapidly dried stains..........	6	18	K.O.H. & M.F.	1 to 2 days.	10 to 40	500	1-3400	1-3400
Wolf.........	Glass............	7 days..	Rapidly dried stains..........	1	50	K.O.H. & M.F.	1 to 2 days.	5 to 20	1,000	1-3450	1-3450
Dog..........	Cloth	7 days..	Rapidly dried stains..........	4	12	K.O.H. & M.F.	1 to 2 days.	5 to 50	500	1-3650	1-3580
Rabbit.......	Knife............	7 days..	Rapidly dried stains..........	10	30	K.O.H. & M.F.	1 to 2 days.	5 to 50	1,000	1-3700	1-3602
Ox...........	Cloth............	7 days..	Rapidly dried stains..........	10	30	K.O.H. & M.F.	1 to 2 days.	20 to 40	1,000	1-4240	1-4200
Sheep........	Glass............	7 days..	Rapidly dried stains..........	3	9	K.O.H. & M.F.	1 to 2 days.	50	500	1-5060	1-5000
Goat.........	Knife..........	7 days..	Rapidly dried stains..........	3	9	K.O.H. & M.F.	1 to 2 days.	50	500	1-6200	1-6100

[1] "K.O. H." stands for 33 per cent solution of caustic potash.

[2] "M.F." stands for Müller's fluid.

TABLE OF PROFESSOR THEO. G. WORMLEY'S MEASUREMENTS.

EXAMINATION OF OLD BLOOD STAINS.

Animal.	Age of Stain.		Remarks.	Average.	Fresh Blood.
(1) Human	2 months	old.	Stain, unknown..........	1-3358th inch.	1-3250th inch.
(2) "	2½ "	"	Stain.....................	1-3236th "	" "
(3) "	3 "	"	Stain.....................	1-3384th "	" "
(4) "	19 "	"	Clot.	1-3290th "	" "
(5) Elephant.....	13 "	"	Clot.....	1-2849th "	1-2738th "
(6) Dog..........	4 "	"	Trace of stain, unknown.	1-3626th "	1-3561st "
(7) Rabbit.......	18 "	"	Clot......................	1-3683d "	1-3653d "
(8) Ox...........	16 "	"	Stain.....................	1-4544th "	1-4219th "
(9) "	32 "	"	Stain, unknown.	1-4495th "	" "
(10) "	4½ years	"	Clot.....................	1-4535th "	" "
(11) Buffalo	18 months	"	Clot......................	1-4312th "	1-4351st "
(12) Goat..........	17 "	"	Stain.....................	1-5897th "	1-6189th "
(13) Ibex..........	18 "	"	Clot.	1-6578th "	1-6445th "

"In the case of the human blood, No. 1, two months old, the deposit was in the form of a thin stain on muslin, and its nature, other than that it was mammalian blood, was unknown at the time of examination. The corpuscles were readily found, and two series of thirty corpuscles each were measured. In the human blood two and a half months old, fifty corpuscles, ranging from $\frac{1}{3,125}$ to $\frac{1}{3,448}$ of an inch, were measured.

"The blood stain of the dog, No. 6, was prepared by Dr. Frankenberg, and consisted of a single stain so minute as to be barely visible to the naked eye: its nature at the time of the examination was unknown. In this instance only fifteen corpuscles were measured.

"In the ox blood four and a half years old, the corpuscles were rather readily obtained, and two closely concordant series of measurements were made.

"In examinations of this kind it should be borne in mind that certain portions of a deposit may fail to yield satisfactory results, while from other portions the corpuscles may be readily obtained."

THE INFLUENCE OF DISEASE ON THE RED CORPUSCLES.

Certain diseases may alter the size of the red corpuscles in the living body as well as the relative proportion of the red and the white corpuscles. Some diseases will diminish their diameter such as high fever, diphtheria, and septicæmia, while others increase the diameter of many of them, as in some of the anæmias. In pernicious anæmia, and in some cases of leukæmia, we may find some nucleated red corpuscles. Manasseïn found the red corpuscle diminished by septic fever and enlarged by extreme cold, and in narcotic states produced by alcohol, hydrocyanic acid, and morphine. Formad disputes this statement in regard to alcohol in man, as he has examined the blood in many fatal cases of alcoholism and has not found any increase in the diameter of the red corpuscle. Manasseïn's results were obtained by experimenting upon animals.

CONCLUSIONS.

From my own experience in the examination of numerous specimens of dried blood in medico-legal cases and in dried blood of known origin, I am satisfied that, if the blood is dried properly, a sufficient number of red corpuscles of normal size and shape can be obtained to give as satisfactory an average as in the case of fresh blood, and that, whenever a satisfactory average can be obtained, as from the measurement of several hundred corpuscles of normal size, we are warranted in forming an opinion within certain limits as to the nature of the animal from which the blood in the dried stain originated.

If the red corpuscles are seen to be nucleated, we may decide at once that the blood did not originate from a mammal, but from one of the oviparous animals. If the corpuscles are biconcave disks having an average diameter of between $\frac{1}{3,100}$ and $\frac{1}{3,300}$ inch, we may say at once that it is not the blood of any animal whose corpuscles measure less on the average than $\frac{1}{4,000}$ inch. This includes all of the ordinary domestic animals except the dog, unless possibly the rabbit and Guinea pig be classed among the domestic animals. The corpuscles of the ox, horse, pig, cat, sheep, and goat, being all less than $\frac{1}{4,000}$ inch in diameter, can, under favorable conditions, be distinguished from those of man in dried stains. In addition to this we may state that these measurements ($\frac{1}{3,100}$ to $\frac{1}{3,300}$ inch) are *consistent* with this blood being of human origin.

If corpuscles of normal shape are found and the measurement of these corpuscles shows them to average less than $\frac{1}{4,000}$ inch, we may state as positively that they are not human blood corpuscles, but are consistent with the blood of those mammals whose corpuscles approximate in size those of the given stain.

By far the majority of recent investigators within the last twenty years are fairly well agreed upon this, that it is possible in the case of dried stains to discriminate between human blood and that of most of the domestic animals, but there are some who think that the range of variation in the size of the corpuscles in the same individual is too great to permit of a positive opinion.

The Committee of the Society of Legal Medicine of France agrees in the main with the above, but in their conclusion with reference to this point they have worded their sentence rather loosely. I give the following translation, as literally as possible, of their opinion:[1]

"The red corpuscles thus obtained [from dried stains after treatment with a restoring fluid] are sometimes colored yellow as in their normal state and are disk-shaped, sometimes globular and spherical like corpuscles swollen with water, sometimes crenated and reduced to a small globule with double outline, and colored. The diameter of these corpuscles is variable, since some are of the normal size of 0.007 millimetre, while others rendered spherical, withered, or reduced to a simple outline are smaller.

"These variations of volume and form of the corpuscle, at first dried and afterward remoistened, render it often very difficult and even impossible to solve the question whether they belong to the blood of man or to that of certain mammals in whose blood the diameter of the corpuscles comes very near the diameter of human blood corpuscles."

Their concluding instruction with reference to this point is as follows:

"With the pieces thus received the expert first, by means of the microscope, determines the red corpuscle in the fresh blood or the stain; this will be easy by observing the precautions mentioned above, if the stains are not too old. He will measure the blood globules, and can then affirm whether or not he is dealing with human blood."[2]

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[1] "Instruction pour servir à déterminer les éléments constituants du sang dans les taches," rédigée par une commission composée de MM. Mialhe, Mayet, Lefort, et Cornil. Annales d'Hygiène, July, 1873, p. 191.

[2] Page 202.

Rabuteau disagrees with the final sentence as applied to dog's blood.[1]

Vibert, an eminent hæmatologist, gives a very carefully worded opinion as to the statement which he considers an expert warranted in making in a medico-legal case. As in the above case I give a literal translation:[2]

"In conformity with the scientific facts the expert should conclude as follows: Such a stain was not made by the blood of such an animal (ox, sheep, horse, as alleged by the accused), it came from a man or from a mammal whose corpuscles have a size approximating those of man (*'de dimensions voisines'*) (dog, rabbit)."

The same writer also states:[3]

"It is always impossible to affirm that a stain was formed by human blood. It is only permissible to state, in a certain case, that it could have originated from human blood."

The late Dr. Joseph G. Richardson, whose work has been frequently referred to above, and whose early publications created much discussion both in this country and in Europe, and did more to stimulate the investigation of this subject with the higher powers of the microscope than that of any other hæmatologist, gives his opinion as follows:

"We are now able by the aid of high powers of the microscope, and under favorable conditions, to positively distinguish stains produced by human blood from those caused by the blood of any of the animals just enumerated [pig, ox, red deer, cat, horse, sheep, and goat], and this even after the lapse of five years from the date of their primary production."

Prof. Theodore G. Wormley, of the University of Pennsylvania, whose careful work upon blood, as well as upon poisons, is well known by all scientists of the present day, expresses his conclusion as follows:

"The microscope may enable us to determine with great certainty that a blood is NOT that of a certain animal and is CONSISTENT with the blood of man; but in no instance does it, in itself, enable us to say that the blood is really human, or indicate from what particular species of animal it was derived."[1]

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[1] Revue des Sciences Médicales, 1874.

[2] "Nouveau Dictionnaire de Médecine et de Chirurgie pratique," article Sang, xxxii., p. 408.

[3] Archives de Physiologie, 1882.

Dr. Masson, of the French army, whose measurements of blood corpuscles are given in one of the above tables (p. 50), states as the result of his numerous examinations of dried blood, as follows:[2]

"If under favorable conditions the difference in the average diameter of the corpuscles of two animals is not greater than 0.0003 or 0.0004 of a millimetre, it will be impossible to discriminate between them with certainty. It is impossible to distinguish the blood of a man from that of a Guinea pig, the blood of the dog from that of the rabbit, the blood of the pig from that of the ox; but we can distinguish with certainty the blood of man and of the Guinea pig from that of the dog and rabbit, and the blood of these last from that of the pig, ox, and cat.

"If we take as the standard the figures given in the 'instruction' of the Society of Legal Medicine, if we admit that the human corpuscles are 0.0075 mm. ($\frac{1}{3,386}$ inch) and those of the dog 0.0073 mm. ($\frac{1}{3,479}$ inch), we would decide that the discrimination between the blood of these two animals is impossible. If, on the contrary, we accept the figures of Roussin, Tourdes, and Dragendorff, 0.0077 mm. ($\frac{1}{3,300}$ inch) and 0.0070 mm. ($\frac{1}{3,628}$ inch), with which our measurements more nearly agree, we will be warranted in concluding that the discrimination between them can be established. And, as a matter of fact, in examining preparations (of dried blood) of unknown origin we have always obtained such figures that we have been able to decide with certainty."

And, in another place, in speaking of dried stains particularly, he says:[3]

"Our experience has demonstrated that with reference to human blood the diagnosis from the blood of the pig, ox, and cat is easy, from that of the dog difficult ('*delicat*'), from that of the rabbit uncertain, and from that of the Guinea pig impossible."

Professor Formad, whose work has been frequently referred to in the preceding pages, and whose tables of the measurement of fresh and dried blood corpuscles have been quoted, gives his conclusions with regard to fresh blood as follows:[1]

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[1] *Loc. cit.*, p. 736.

[2] Annales d'Hygiène, 1885, p. 542.

[3] *Ib.*, p. 547.

"1. The blood corpuscles of birds, fishes, and reptiles, being oval and nucleated, can never be mistaken for human blood.

"2. Fresh human blood cannot be mistaken, under the microscope, for the blood of any animal, the corpuscles of which have a mean diameter of less than $\frac{1}{4,000}$ or even $\frac{1}{3,600}$ of an inch.

"3. (*a*) If the average diameter of blood corpuscles in fresh blood is less than $\frac{1}{4,000}$, then it cannot possibly be human blood.

"(*b*) If the diameter is more than $\frac{1}{3,500}$, then it may be human blood.

"(*c*) If the blood corpuscles, after exhaustive measurement, give a mean diameter of more than $\frac{1}{3,300}$, then it *is* human blood (provided it is not the blood of one of the wild beasts referred to)."

And regarding the diagnosis of blood in its dried state he says:[2]

"We have seen that blood can be diagnosed in its dried state and in blood stains with the same certainty as fresh blood, provided the drying of the blood was rapid and perfect. The blood corpuscles preserve fully their color, size, shape (bi-concavity) and even their arrangement into rouleaux (only occasionally are such corpuscles a trifle smaller than in fresh blood)."

Prof. John J. Reese, the eminent toxicologist and editor of the eighth American edition of "Taylor's Medical Jurisprudence," gives as his opinion:

"By the employment of these high powers there is no difficulty in positively distinguishing between the human blood corpuscles and that of any animal whose corpuscle is less than $\frac{1}{4,000}$ of an inch."

Prof. Marshall D. Ewell, professor of common law in Union College of Law, Chicago, himself a skilled microscopist, arrives at conclusions which are directly the opposite of those quoted above. In quite an elaborate paper read before the Medico-Legal Society in 1892,[3] entitled "A Micrometric Study of Four Thousand Red Blood Corpuscles in Health and Disease," the following conclusions are given:

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[1] "Comparative Studies of Mammalian Blood," the Journal of Comparative Medicine and Surgery, July, 1888, p. 284.

[2] *Ib.*, p. 294.

[3] The Medico-Legal Journal, Sept., 1892, p. 175.

"There are such large discrepancies between the averages obtained from the measurement of the *fresh* blood corpuscles of animals of the same species, and between measurements of the same objects by different observers, as to throw doubt upon published results.

"There is no advantage in using very high powers in such observations.

"Drying of the blood corpuscles in a clot multiplies the difficulty of identification. It has never been proven that dried corpuscles can be restored to their normal proportions.

"The mean size of the red corpuscles of very young animals is larger, and their size varies between wider limits, than in adults.

"Many diseases alter the size of red corpuscles; especially is this so in microcythæmia.

"Fasting diminishes both the size and number of the red blood corpuscles. So also in the case of various drugs.

"In view of the foregoing, it is impossible in the present state of science to say of a given specimen of blood, fresh or dry, more than that it is the blood of a mammal."

I have only quoted those conclusions of Professor Ewell's which refer directly to the discrimination between the different kinds of mammalian blood.

Dr. Robert Reyburn, vice-president of the American Microscopical Society, speaks very positively with regard to the possibility of distinguishing the different kinds of blood as follows:[1]

"1. Blood stains can be certainly and absolutely differentiated from stains produced by other colored fluids, by the presence or absence of the red blood corpuscles.

"2. The blood corpuscles of birds, fishes, and reptiles, being oval and nucleated, can never be mistaken for those of human blood.

"3. If the average diameter of the blood corpuscle in any specimen of blood (containing at least 100, and better 500 corpuscles) is less than $\frac{1}{4,000}$ of an inch, it cannot possibly be human blood.

"4. If the blood corpuscles have an average diameter of from $\frac{1}{3,200}$ to $\frac{1}{3,300}$ of an inch then *it is human blood* (excluding the blood of the beaver, Guinea pig, kangaroo, monkey, muskrat, porcupine, seal, or wolf). None of these are domestic animals, and stains produced by their blood can scarcely ever be met with under such circumstances as to be confounded with the stains of human blood.

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[1] The Medico-Legal Journal, Sept., 1892, p. 167.

"5. Blood corpuscles of the dog $\frac{1}{3,580}$, rabbit $\frac{1}{3,662}$, ox $\frac{1}{4,200}$, pig $\frac{1}{4,250}$, horse $\frac{1}{4,310}$, sheep $\frac{1}{5,000}$, goat $\frac{1}{6,100}$, can, by the use of high magnifying power, and the careful counting of 100 to 500 corpuscles, be differentiated from human blood corpuscles, both in recently shed blood and dry blood stains."

Mr. Clark Bell, President of the International Congress of Medical Jurisprudence, and editor of the last (eleventh) American edition of "Taylor's Medical Jurisprudence," gives his conclusion as follows:[1]

"Since the researches of Dr. Richardson great advances have been made by able observers and it is now generally believed that with a skilled and careful microscopist, and a good instrument of high powers, it will generally be possible to diagnosticate a human blood stain from that of any of the lower animals, with the possible exception of the Guinea pig and the opossum. This, however, has not yet been conceded by some very high authorities both American and European."

OTHER STAINS CONTAINING BLOOD.

An expert is frequently called upon to give his opinion in the case of an acknowledged human blood stain as to whether or not it was of menstrual or of nasal origin, as may have been alleged. Cases have also occurred in which it was of importance to determine whether a blood stain had been caused by the hemorrhage following an abortion or confinement. In such cases the diagnosis can only be made by the recognition of other and characteristic morphological elements associated with the blood corpuscles, and in some cases also the peculiar location of the stain is of importance. Of especial importance is the admixture with the blood corpuscles of epithelial cells of various kinds, pus corpuscles, particles of fœcal matter, mucous coagula, and spermatozoa.

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[1] The Medico-Legal Journal, Sept., 1892, p. 142.

Menstrual Stains.—Menstrual blood does not always have the same composition. It may vary much in different persons, and in the same individual at different times; in some cases, in order to assist in arriving at an opinion as to the probable menstrual origin of a stain, we must take into consideration individual peculiarities, such as the habits of cleanliness, mode of living, and health of the person, as well as the exact period of menstruation, and the abundance of the menstrual flow, generally or during the particular period in question.

Usually a stain made by menstrual blood has mixed with it other substances, sometimes in considerable proportion, varying according to the period of menstruation, or rather according to the amount of the flow, and also varying according to the condition, healthy or diseased, of the vaginal and uterine mucous membrane. Unless the flow of blood by which the stain was made was excessive, we will be liable to find, on examination with the microscope, mixed with the blood corpuscles a considerable number of squamous epithelial cells having a well-marked nucleus coming from the vaginal mucous membrane. We may also find in exceptional cases ciliated epithelium coming from the mucous membrane of the uterus.

The vaginal cells are large, squamous epithelial cells having, as a rule, rather larger nuclei than the similar cells coming from the mucous membrane of the mouth or tongue, and they are frequently arranged in flakes or masses containing several layers of cells; rarely a vaginal cell contains two or more nuclei. In size these cells vary very much, but the majority of them have a diameter of from three to six times that of a normal red blood corpuscle. Even in a healthy condition of the vaginal and uterine membranes quite a large number of these cells is exfoliated. If there be any irritation or inflammation of the membranes, as in leucorrhœa or gonorrhœa, these cells will be separated in much larger number and will be mixed with pus corpuscles and leucocytes varying in amount according to the extent and severity of the inflammation or irritation.

When the flow of blood is excessive, a menstrual blood stain may be presented for examination in which none of the vaginal cells can be detected, especially if the spot be a small one. In such a case we can only determine that the stain contains blood, and are not warranted in giving an opinion as to whether it was menstrual blood or not. Toward the end of the menstrual period, or when the flow of blood is comparatively slight, the proportion of vaginal cells and leucocytes mixed with the blood corpuscles will be larger. These may sometimes be recognized more readily by treating the preparation on the slide with a small drop of dilute acetic acid which will render the nuclei of the cells and of the leucocytes more plainly visible.

In preparing these stains for microscopic examination the same method should be adopted as in the case of ordinary blood stains. They may be treated with the same remoistening fluids on a glass slide, and examined with the microscope in the same way for the recognition of the blood corpuscles and the other elements mixed with them.

It is frequently stated, particularly in the older works, that menstrual blood contains no fibrin and does not coagulate. This is not true; coagula may form after the menstrual blood has left the vagina when the flow is abundant, and coagulated blood has been found within the vagina and the uterus during menstruation. In dried stains of menstrual blood, coagula of fibrin may be found with the corpuscles and vaginal cells. Menstrual blood frequently contains a smaller proportion of fibrin than blood coming directly from the blood-vessels, since it may be diluted by the fluids from the uterus and vagina.

The location of such stains, as upon bedding or underclothing, may be of importance in the recognition of menstrual or lochial stains. Among uncleanly women these stains are said to be found more frequently upon the back part of an undergarment or night-dress than upon the front.

Lochial Stains.—A stain formed by blood coming from the uterus after an abortion or after confinement has essentially the same elements as a menstrual stain. It is liable to contain the squamous epithelium from the vagina in considerable quantity, and also ciliated epithelial cells from the uterus, and pus corpuscles in addition to the blood and fibrin; shreds of the uterine mucous membrane may also be found in the stain.

In some cases the blood may become diluted with the **liquor amnii** and cause a stain in appearance like a diffused blood stain. Cases of this kind have been submitted to legal investigation, and experts requested to determine, if possible, whether a given stain was a menstrual blood stain, or one resulting from hemorrhage following an abortion. In one case a committee of the French Academy, to whom this question was referred, reported that there was no certain method by which menstrual blood could be distinguished from that resulting from an abortion.[1] If the blood were diluted with *liquor amnii* so as to cause a diffused stain, the fabric, if linen or cotton, would be stiffer than a similar diffused stain produced by diluting the blood with the same quantity of water, since the *liquor amnii* is an albuminous fluid. The albumin can be extracted from such a stain by treating it with cold water, and can be detected by chemical tests, but this gives us no assistance in the diagnosis of the stain, since albumin derived from the blood serum will be present in the stain.

Nasal Blood Stains.—It is often alleged that blood stains upon clothing were caused by bleeding from the nose. As in the case of menstrual stains, the diagnosis must be made by the identification of the characteristic morphological elements which accompany the blood corpuscles in the stain. These characteristic elements may or may not be present in a stain caused by blood from the nose, so that, although it may be possible to say in some cases that a given blood stain did originate from the nose, in other cases we cannot say that the stains could not have been caused by epistaxis, because we did not detect in them the characteristic cells; this is especially liable to be the case if the hemorrhage is abundant, when much of the blood may be pure and resemble in every respect blood coming from a wound.

If but little blood flows during the epistaxis, and also if the stains are small and caused by the forcible expulsion of the blood from the nostril by blowing forcibly through it, the stains will usually contain epithelial cells from the Schneiderian mucous membrane, and will also be mixed with more or less of the mucous secretion from the numerous glands located in the mucous membrane of the nose.

In dried blood stains emanating from the nose, we may expect to find, unless the hemorrhage was abundant, in addition to the blood corpuscles a larger or smaller quantity of coagulated mucus, together with ciliated and columnar epithelial cells which cover the lining membrane of the nose. If the blood be mixed with much nasal mucus, the appearance of the stain will be different from that of a pure blood stain; it will be more bulky and of a paler color, and is usually of more irregular shape, since a mass of mucus mixed with blood is of more gelatinous consistency and less fluid than blood alone; after it has become thoroughly dry, its surface has a glistening appearance, and the dried mass is hard and brittle. If it is then moistened with water, the mass swells, becomes softer, and soon has an elastic feel. Examined under the microscope such a mass will be found to contain coagulated mucus mixed with blood corpuscles, leucocytes, and cells which have separated from the nasal membranes. The location of such stains should be carefully observed as sometimes being of importance in deciding as to the probability or improbability of their being of nasal origin.

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[1] Annales d'Hygiène, 1846, i., p. 181.

SEMINAL STAINS.

The detection of seminal stains upon clothing and other substances is of frequent medico-legal importance in cases of alleged or suspected rape or sodomy. These stains may be simple, containing dried seminal fluid alone, or they may be mixed with blood or other animal fluids or substances, such as particles of excrement, vaginal mucus, gonorrhœal discharge, or urine. The usual substances submitted for examination in such cases are bedding or underclothing, but sometimes other articles of clothing, dried accumulations taken from the body, particularly from the neighborhood of the genitals, or mucus taken from the vagina in cases of alleged rape, may require expert examination. In rape or sodomy the seminal fluid is apt to adhere tenaciously to the hair about the genitals or anus of the victim, if it comes in contact with it.

A dried seminal stain on clothing produces but little change in the appearance of the cloth, particularly if it is somewhat soiled or is colored; if on white linen or cotton, the stained portion appears a little darker with a tinge of yellow or gray, and the fibre, as is the case when stained with blood or any albuminous fluid, is somewhat stiffened, this stiffening being quite plainly perceptible to the feel, as if that part of the cloth had been starched slightly; at the same time the meshes of the cloth may be seen to be occluded if it be held up to the light. The outline of the stain is irregular, and at the edge it is, as a rule, a little more deeply colored. These appearances may also be produced by other albuminous or gelatinous fluids, and they are only of value as indicating in any suspected case the portions of the fabric to be subjected to microscopic examination for the recognition of the spermatozoa, which are characteristic of seminal fluid.

There are no chemical tests by which seminal stains can be recognized. The seminal fluid is slightly albuminous, has a slightly alkaline reaction, and contains an abundant quantity of phosphates. When seen in bulk it is more or less ropy and is slightly opalescent; if treated with a very dilute solution of the carbonate of potassium or sodium or with a little dilute ammonic hydrate, it is rendered more fluid and more transparent. The dried stain has no odor, but in some cases, if it be moistened with warm water, a faint odor resembling that of fresh seminal fluid may be evolved.

A seminal stain can only be diagnosticated by the recognition of the characteristic morphological elements, the spermatozoa, by microscopic examination. These are usually associated with the various kinds of cells and spherical bodies from the seminal passages, and also with some cells from the urethra and the urethral ducts and glands. The spermatozoa are tadpole-shaped bodies with ovoid heads and a long tail several times longer than the head. Spermatozoa differ in size and somewhat in the relative length of the head and tail in different animals, but in man they are about $\frac{1}{500}$ to $\frac{1}{550}$ of an inch long, the length of the head being about the same as the diameter of a normal blood corpuscle, from $\frac{1}{3,000}$ to $\frac{1}{3,100}$ of an inch. Their appearance is so characteristic that they cannot be mistaken for anything else, animal or vegetable. They retain their life for a long time, if kept at the temperature of the body, and have been found alive in the healthy vaginal secretion several days after coitus.

In preparing a stain for microscopic examination for spermatozoa great care should be exercised, since when dry they are very brittle and apt to be broken, the head separated from the tail, by careless manipulation. The stain should first be softened by moistening it with water, or a dilute solution of common salt or glycerin; after it is thoroughly softened a portion of the stain may be gently scraped from the fabric and transferred to a glass slide, or, better, a drop of the fluid may be gently squeezed from the fabric on to the slide; this fluid, which is usally more or less opalescent, may be covered with a covering-glass and examined under the microscope with a power of 400 or 500 diameters, with which the spermatozoa may readily be detected. In some cases their recognition may be facilitated by staining them with a little solution of iodine or a solution of eosin. The addition of a trace of ammonic hydrate to the moistening fluid may also in some cases assist in their detection by diminishing the turbidity of the fluid. In some stains where the fluid has not penetrated the fabric, so that a thin dried crust has formed on the surface, a thin section may be shaved from the crust by a sharp razor and transferred to a slide, where it may be treated with the moistening fluid to better advantage than on the cloth itself.

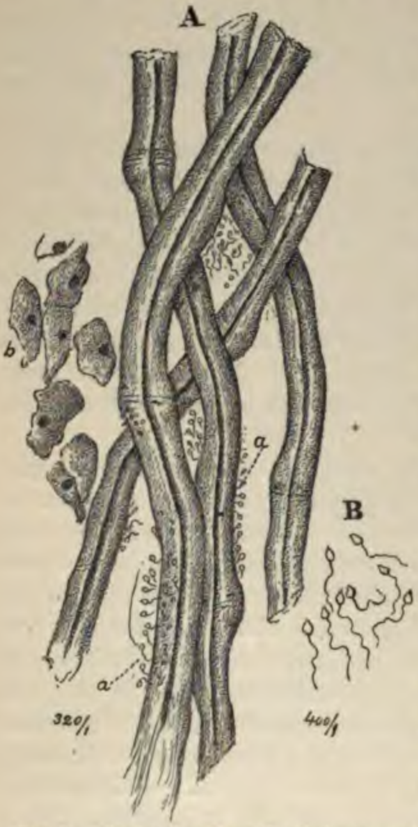

FIG. 21.—Fibres taken from the Undergarment of a Young Girl, Suspected to have been the Victim of Rape. *A*, *aa*, Groups of spermatozoa, in part closely adherent to the linen fibres; *b*, cells, like vaginal cells, found in the seminal stain; ×320. *B*, Spermatozoa from fresh seminal fluid; ×400.[1]

Everything associated with the spermatozoa should be carefully noted, since it may happen that some substance may be found adherent to the seminal stain which will tend to connect the guilty person with the crime in a case of rape. For instance, we may detect fibres of cloth of various kinds, or fragments of hair, which by some peculiarity of material or color may be identified as belonging to the accused; other substances, such as pus and blood corpuscles, or cellular elements of various kinds, may also be recognized. Such extraneous substances should always be carefully noted whether they appear at the time to have any importance or not.

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[1] From "Anleitung zur Untersuchung verdächtiger Flecke, nach der vom Medicinal-Departement des Ministerii des Innern zu St. Petersburg, im Jahre 1870 veranstalteten russischen Ausgabe," St. Petersburg, 1871.

If spermatozoa are detected in a stain, it is positive proof that that stain contained seminal fluid. The reverse, however, may not be true; if a stain does not contain spermatozoa it is not absolute proof that it was not caused by seminal secretion, since spermatozoa are not present in the seminal fluid of young boys or very old men, and they may be absent from the secretion of an apparently healthy adult, as in old disease of the testicles, or in some cases after a double epidydimitis, resulting from a gonorrhœa, in consequence of which the seminal ducts or tubules may have become permanently occluded by the inflammatory exudation. Spermatozoa can be detected in dried stains for an indefinite period after the stain was formed. Bayard has detected them after six years,[1] and Roussin after eighteen years.[2]

Many other animal fluids may produce stains resembling in their gross appearance seminal stains, as for instance vaginal mucus, leucorrhœal discharge, pus, and some expectorated fluids. These of course can be distinguished from seminal stains by microscopic examination, since they will not contain any spermatozoa, but will, as a rule, contain other morphological elements which will enable the expert to decide as to their origin.

A stain caused by vaginal mucus has when dry a distinct yellowish or yellowish-green tinge, and is generally easily removed from cloth by simple rubbing, since the fluid does not penetrate the fibre of the cloth as readily as blood or seminal fluid. The microscopic examination will also reveal the presence of numerous vaginal cells and probably a few leucocytes, or if the stain be caused by a leucorrhœal discharge, numerous pus corpuscles will be seen in addition to the vaginal cells. Stains made by pus will have, when dry, a decided greenish or greenish-yellow color, and many pus corpuscles may be detected by microscopic examination of the remoistened material.

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[1] "Man. Prat. de Méd. Lég."

[2] Annales d'Hygiène, 1867, i., 152.

THE

EXAMINATION OF HAIR.

BY

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THE EXAMINATION OF HAIR.

In numerous cases which have required medico-legal investigation, the examination of hair has been found to be of great importance, and the nature of the information gained by such an examination is very varied according to the circumstances in individual cases. It is self-evident that the finding of human hair, or fragments of hair, in certain locations, as upon a weapon together with blood, or upon the clothing of a person suspected of a crime, if the hair is unlike that of the accused but does resemble that of the victim, may, under certain circumstances, be valuable pieces of information, particularly in cases in which circumstantial evidence must be relied upon.

The principal questions to be answered by the examination of hair, in medico-legal cases, are:

1st. Is the hair that of a human being or of an animal?

2d. If from a human being, from what portion of the body does it probably come?

3d. From what individual? This question involves variations in hair due to differences in the age, sex, and complexion of different individuals.

4th. Was the hair in question pulled out forcibly, did it fall out spontaneously, or was it cut off?

The answers to these questions depend upon variations in structure, form, and color of different hairs, and, in some cases, the location of the hairs in question and the presence of other substances with them furnish important information.

In studying the changes seen in the examination of hair in medico-legal cases, we need to consider only briefly the structure of hair in general. That portion of the hair which projects above the surface of the skin is called the *shaft*, and that portion which is beneath the surface of the skin is called the *root* of the hair. The shaft is more or less cylindrical, of varying length, and when its growth has been uninterrupted it ends in a point. The root terminates in a thickened and rounded end called the bulb.

The *shaft* of the hair is generally made up of an outer scaly coating called the *cuticle*, which consists of thin, transparent scales which overlap each other like shingles on a roof, the free edge of each layer being toward the point of the hair. So that when we have only a short piece of the shaft of the hair to examine, we can tell which end was toward the point and which toward the root.

In the centre of the shaft of most hairs is the *medulla*, or *medullary mass*, which is made up of cells of various forms, and often numerous small cavities containing air are present in larger or smaller portions of the medulla. The medullary portion is absent in some hairs, particularly in the downy hairs, and in human head hairs it is frequently absent in a portion of the shaft, and sometimes it is absent entirely. In order to recognize the cells and air spaces in the medulla it is necessary to use high powers, and to render the cortical portion, in the case of dark hairs, transparent by treating the hair with dilute nitric acid. The air spaces by transmitted light look black and by reflected light silvery white.

The middle layer between the cuticle and medulla is called the *cortical portion* of the hair, and consists of horny, elongated cells tightly pressed together. These may be separated and made visible by treating the hair with concentrated sulphuric acid. A few air spaces may sometimes be found in this portion of the shaft also. In this part of the hair may be seen the pigment granules which vary in color according to the color of the hair.

The *root* of the hair consists of a prolongation of the shaft beneath the surface of the skin where it is surrounded by the *root sheath*, two layers of which have been recognized, called the external and internal layers, and by the hair follicle. The terminal portion of the root, the bulb, is more important in medico-legal examinations than the upper part of the root. In growing hairs the bottom of the bulb is open and into the hollow above projects the papilla, which rises from the fundus of the follicle. In hairs which have reached their normal growth, and are ready to be cast off, this hollow in the bottom of the bulb becomes closed, and the bulb becomes rounded or pointed at the bottom instead of hollow. The relation of the above-mentioned parts of the hair are shown in the accompanying figure taken from Frey ("Histology and Histochemistry of Man," p. 389).

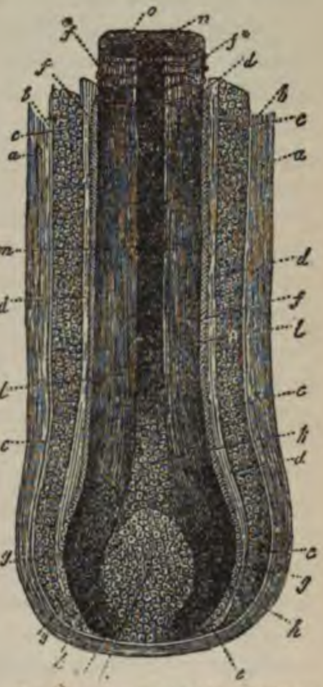

Fig. 22.—Human Hair and Follicle. *a*, Fibrous follicle; *b*, transparent internal layer of the latter; *c*, the external, and *d*, the internal root-sheath; *e*, transition of the external sheath into the hair-bulb; *f*, hair-cuticle, seen at *f** in the form of transverse fibres; *g*, the lower portion of this structure; *h*, cells of the hair-bulb; *i*, hair papilla; *k*, cells of the medullary part; *l*, cortical portion; *m*, medulla containing air; *n*, transverse section of the latter; *o*, cortex.

DISTINCTION BETWEEN HUMAN AND ANIMAL HAIRS.

It frequently happens that we are unable to distinguish between the hair of human beings and that of animals by the unaided eye, but generally there is no difficulty when the hairs in question are examined with the microscope. The principal differences are in the cuticle and in the relative proportion between the cortical and medullary portions in the shaft of the hair. In human hair the scales of the cuticle are finer, and the lapping of one layer over the next can only be made out on the edge of the shaft by using high magnifying powers, while in most animals the scales are coarser, so that the notches formed by one layer of scales on the other can easily be seen on the edge of the shaft with low magnifying powers. In dark-colored hairs it is sometimes necessary to dissolve the pigment with dilute nitric acid before the scales of the cuticle can be plainly seen. In the body-hair of the cat the coarseness of the scales is especially noticeable; they become broader and higher from the point toward the root end of the shaft, so that the shaft has a jointed appearance like that of the horse-tail; from the point at which the medulla begins to be seen this jointed appearance is not so marked, but from that to the root the scales present a much coarser network than is ever seen in human hair. In the hair of the hare and the rabbit also the network formed by the scales is much coarser than in human hair.

Much more important in distinguishing between human and animal hair than the peculiarities of the cuticle is the relative diameter of the medullary substance and the cortical portion of the hair. In human hair, as has been mentioned above, the medullary substance may be entirely wanting, or present only in certain portions of the course of the hair, and when it is present, it occupies relatively but a small proportion of the total diameter of the shaft, which is composed chiefly of the cortical substance. In the hair of animals the medulla is almost always present in all of those hairs which could by any possibility be mistaken for human hair from their gross appearance. And when present, the medulla of animal hairs occupies a much larger portion of the diameter of the shaft than is ever the case with human hair. In some animal hairs the medulla occupies so much of the diameter of the shaft that the cortical portion can scarcely be seen. On account of this difference, and the feathered and jointed appearance of the cuticle in some cases, the fine downy hairs of animals can be easily distinguished from the downy hairs of man and of the fœtus. The following table of Oesterlen's[1] gives the average diameter of the shaft and medulla in various kinds of hair. These measurements are averages obtained from a large number of hairs.

These figures are those of the average measurements of the largest part of the shaft, and, as mentioned above, were obtained from a large number of hairs.

In some cases we may be able to detect the animal origin of a hair by the sudden changes in the color in the course of the same hair, as in some cat hairs.

DISTINCTION BETWEEN HAIRS FROM DIFFERENT PORTIONS OF THE BODY.

This is by no means always possible, particularly where there are only a few hairs or, as often happens, only a single hair submitted for examination; but information of greater or

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[1] "Das menschliche Haar, und seine gerichtärztliche Bedeutung," Tübingen, 1874, and Maschka's "Gerichtliche Medicin," vol. i., p. 511.

	Medulla.	Shaft.
MEN.		
Top of head	0.006 mm. = 1-4233 in.	0.052 mm. = 1-488 in.
Crown	0.010 mm. = 1-2540 in.	0.053 mm. = 1-479 in.
Temple	0.014 mm. = 1-1814 in.	0.096 mm. = 1-264 in.
Forehead	0.012 mm. = 1-2117 in.	0.091 mm. = 1-279 in.
Eyelashes	0.004 mm. = 1-6350 in.	0.043 mm. = 1-591 in.
Eyebrows	0.010 mm. = 1-2540 in.	0.042 mm. = 1-604 in.
Mustache	0.032 mm. = 1-794 in.	0.123 mm. = 1-206 in.
Axilla	0.008 mm. = 1-3175 in.	0.079 mm. = 1-321 in.
Pubes	0.015 mm. = 1-1693 in.	0.099 mm. = 1-256 in.
WOMEN.		
Top of head	0.007 mm. = 1-3629 in.	0.043 mm. = 1-591 in.
Crown	0.012 mm. = 1-2117 in.	0.081 mm. = 1-313 in.
Temple	0.013 mm. = 1-1953 in.	0.066 mm. = 1-385 in.
Forehead	0.008 mm. = 1-3175 in.	0.054 mm. = 1-470 in.
Eyelashes	0.011 mm. = 1-2309 in.	0.076 mm. = 1-334 in.
Eyebrows	0.014 mm. = 1-1814 in.	0.060 mm. = 1-423 in.
Axilla	0.015 mm. = 1-1693 in.	0.086 mm. = 1-295 in.
Pubes	0.012 mm. = 1-2117 in.	0.105 mm. = 1 241 in.
OLD MAN.		
Top of Head	0.012 mm. = 1-2117 in.	0.059 mm. = 1-430 in.
Crown	0.012 mm. = 1-2117 in.	0.067 mm. = 1-379 in.
Temple	0.014 mm. = 1-1814 in.	0.063 mm. = 1-403 in.
Forehead	0.011 mm. = 1-2309 in.	0.043 mm. = 1-591 in.
BOY—Aged 15 years.		
Top of head	0.012 mm. = 1-2117 in.	0.059 mm. = 1-430 in.
Nape of neck	0.010 mm. = 1-2540 in.	0.061 mm. = 1-416 in.
Crown	0.011 mm. = 1-2309 in.	0.055 mm. = 1-462 in.
Eyebrow	0.011 mm. = 1-2309 in.	0.053 mm. = 1-479 in.
BOY—Aged 1¼ years.		
Forehead	0.009 mm. = 1-2822 in.	0.039 mm. = 1-651 in.
BOY—Aged 6 months.		
Crown	0.010 mm. = 1-2540 in.	0.046 mm. = 1-552 in.
ANIMALS.		
Dog—belly	0.040 mm. = 1-635 in.	0.074 mm. = 1-343 in.
" back	0.048 mm. = 1-529 in.	0.069 mm. = 1-368 in.
White poodle	0.008 mm. = 1-3175 in.	0.025 mm. = 1-1016 in.
White horse—back	0.069 mm. = 1-368 in.	0.114 mm. = 1-223 in.
" " belly	0.036 mm. = 1-706 in.	0.083 mm. = 1-306 in.
Black horse—back	0.040 mm. = 1-635 in.	0.088 mm. = 1-288 in.
" " belly	0.034 mm. = 1-747 in.	0.057 mm. = 1-446 in.
Goat	0.045 mm. = 1-564 in.	0.065 mm. = 1-391 in.
Cow—belly	0.026 mm. = 1-976 in.	0.057 mm. = 1-446 in.
" back	0.026 mm. = 1-976 in.	0.038 mm. = 1-668 in.
Cat—back	0.057 mm. = 1-446 in.	0.075 mm. = 1-338 in.
" belly	0.010 mm. = 1-2540 in.	0.015 mm. = 1-1693 in.
Hare—back	0.048 mm. = 1-529 in.	0.053 mm. = 1-479 in.
" belly	0.046 mm. = 1-552 in.	0.055 mm. = 1-462 in.
Mole—fine	0.006 mm. = 1-4233 in.	0.008 mm. = 1-3175 in.
" coarse	0.018 mm. = 1-1411 in.	0.024 mm. = 1-1058 in.

less importance in assisting us to distinguish between hairs from different portions of the body may be obtained, especially if we have a large number of hairs to examine, by observing their length, diameter, form of shaft, whether purely cylindrical or more or less oval or kidney-shaped, and the appearances of the point, which varies considerably under different circumstances. The short downy hairs (lanugo) can always be easily recognized by their exceeding fineness and delicacy, freedom from color, and entire absence of the medullary canal.

As to the *length* of hair, generally speaking, we find the longest hairs coming from the heads of females. Head-hair and chin-hair attain the longest growth. According to J. Pincus, the typical length of head-hair is from 54 to 78 cm. (22 to 31 inches), and the rate of growth during the first two years is from 2 to 5 mm. ($\frac{1}{12}$ to $\frac{1}{5}$ in.) in ten days. The chin and beard hair is usually kept shaven or trimmed, so that it does not attain, as a rule, great length, but I have seen a man, sixty-five to seventy years old, whose chin-hair had never been cut and had attained a length of nearly seven feet. We find colored body-hairs attaining a length of from 1 to 3 inches in the axilla, on the pubes, and in the male between the pubes and the umbilicus, and on the chest. Short colored hairs are found especially on the arms, legs, and on the face the eyebrows, lashes, and in the nostrils.

The *diameter* of hairs varies greatly, not only that of different hairs from the same location, but also that of the same hair in different portions of its shaft, so that great care should be exercised not to draw too positive inferences from the diameter alone of any given hair. It is only when a large number of hairs can be measured that information of some importance can be gained. From a large number of measurements Oesterlen (*loc. cit.*) reports the following as the average maximum diameter of the shaft of hairs from the location mentioned:

Chin, 0.125 mm. (1-203 in.); genitals 0.121 mm. (1-210 in.); mustache, 0.115 mm. (1-221 in.); cheek whisker, 0.104 mm. (1-244 in.); eyebrow, 0.080 mm. (1-317 in.); eyelid, 0.076 mm. (1-334 in.); nostrils, 0.056 mm. (1-454 in.); scrotum, 0.082 mm. (1-309 in.); and axilla, 0.077 mm. (1-330 in). The average maximum diameter of head-hairs, as a whole, he found to be 0.071 mm. (1-358 in.); that of the hair of the neck, 0.056 mm. (1-454 in.); temple, 0.066 mm. (1-385 in.);

top of head, 0.067 mm. (1-379 in.); forehead, 0.069 mm. (1-368 in.), and crown, 0.075 mm. (1-338 in.). The variations found in the maximum diameters of the shaft of adult human head-hairs was from 0.030 mm. (1-847 in.) to 0.117 mm. (1-217 in.); of the genitals, from 0.064 mm. (1-397 in.) to 0.153 mm. (1-166 in.); and of the beard from 0.062 mm. (1-409 in.) to 0.159 mm. (1-160 in.). It is evident, therefore, that since hairs from the same location may vary so greatly, information of but little importance can be obtained from the measurements of only a single or a small number of hairs in given case, so far as the identification of their location is concerned.

It will be seen from the above measurements that some of the short hairs, like those of the eyelid and eyebrow, which are only from ¼ to ½ inch long, have approximately the same maximum diameter as long head-hairs. In these short hairs, therefore, the diameter must diminish very rapidly in the short distance between the largest part of the shaft and the point, while in the long head-hair this diminution will be very gradual. This may be an important point in distinguishing between a long and short hair from a fragment of hair, such as may be found upon an instrument with which a murder or an assault has been committed. The writer has at the present time a lather's hatchet for examination; in addition to a number of blood-stains upon the hatchet, there were two fragments of hair found sticking in the notches upon the hammer end of the hatchet; these are to be compared with the hair from the head of the victim in the case under investigation, and if they prove to be similar to the head-hairs of the victim, they will, of course, with other circumstances, assist in fixing the identity of this hatchet as the implement with which the murder was committed.

The *form* of the shaft of hairs varies somewhat under different circumstances. Straight hair has a cylindrical shaft, that is, the cross-section is perfectly round, while curly or kinky hairs have a more or less oval or kidney-shape, or sometimes a triangular cross-section of the shaft like the long body-hairs. The head-hairs are almost all straight hairs and have a cylindrical shaft, with the exception of the short curly hair of the negro race.

If we have the pointed end of a hair for examination, some light as to its possible origin may sometimes be gained by the appearance of the point. If the point of the hair is free and the growth has been unrestricted by cutting, or other interference, the point will be exceedingly fine and the end conical. In the short hairs, like the eyelashes, this cone will be a short one, the diameter of the shaft diminishing rapidly toward the point, while in the long head-hairs the diameter diminishes very gradually toward the point, so that the conical form may be almost imperceptible.

If the end of a hair which has been freshly cut be examined, it will be seen that the cut surface is more or less irregular, some of the scales from the cuticle, or some of the fibres of the cortical portion, projecting beyond the main part of the cut section. After a time the cut surface on a living hair, as in the case of the head and beard, becomes rounded off, and finally gradually worn off to a comparatively fine point, but not as fine as the original point of an uncut hair. We can, therefore, generally determine, in the case of a growing hair, whether the cut end is recent or old. In certain cases we may have, for example, a fragment of hair found on some implement, or in a stain mixed with blood, one end of which will be blunt but smoothly rounded or worn off, which will show that the hair was cut some weeks before the fragment was separated from the main body of living hair, while the other end will have the appearance of a freshly cut section, being more or less jagged, according to the sharpness of the cutting instrument. Of course, in such a case the free end of the hair can easily be identified by the direction of the scales of the cuticle.

Hairs which have been exposed to constant rubbing, such as body-hairs which are under the clothing, have their free end considerably changed; the cuticle becomes worn off and the cortical fibres loosened and more or less separated, so that the free end has a somewhat brush-like appearance. After a time these loose fibres may become worn off and the end become more or less rounded. Head-hairs may also be thus changed by constant rubbing with comb and brush.

If the hair be exposed to both constant rubbing and the action of moisture, as in those locations where the sweat glands are numerous, as in the axilla, and about the scrotum, vulva, and perinæum, the free end becomes more or less club-shaped by the loosening of the cortical fibres and the accumulation, in the interstices between the fibres, of more or less deposit resulting from the drying of the sweat mixed with dust, etc.

FROM WHAT INDIVIDUAL DID THE HAIRS IN QUESTION ORIGINATE?

It is usually impossible to answer this question except in a general way, particularly if we have only one or a few hairs to examine. We may say, for example, in some instances, that the hairs examined probably came from a female, from a child, or from a person having hair of a certain color. Usually, however, the question is more limited than the above. In most cases the doubt to be solved is, whether the hair came from a certain individual or not, or whether it came from the accused, or from the victim, in any given case. Thus narrowed, the microscopic examination of the hair may give very important information, and contribute a very important link in a chain of circumstantial evidence. Even in this case, however, it can only be stated that the hair in question is *similar* to that of the individual mentioned and *may* have originated from that individual.

From the length of the hair but little can be determined with certainty. If the hair or hairs submitted for investigation are very long, the presumption is that they came from the head of a woman, or child with long hair, since so few men or boys have long hair. With short hairs, however, we cannot say whether a single short hair came from the head of a man or woman, since new hairs which are constantly growing on the heads of both men and women may be short, and have a fine point.

The diameter of the hair is much more important than the length, especially if a large number of hairs are submitted for examination. For instance, the measurements of Oesterlen (*loc. cit.*) have shown that the average maximum diameter of the head-hair of children is less than that of adults, and also that the hairs of young children have usually no medullary canal. Thus he found that the average maximum diameter of the head-hair of a boy twelve days old was only 0.024 mm. (1-1058 in.); of a boy six months old, 0.037 mm. (1-686 in.); one and one-half years old, 0.038 mm. (1-668 in.); and one fifteen years old was 0.053 mm. (1-479 in.); the average maximum diameter of an adult head-hair being, as mentioned above, 0.071 mm. (1-358 in.). Still, the variations in the diameter of different hairs taken from the same head are so great, that valuable information can only be obtained from such measurements, when a large number of hairs can be obtained for examination.

The color of the hair may, naturally, prove of great assistance, particularly in cases where the question is as to whether the given hairs came from a certain individual or not. The color can be easily identified, either by inspection or by microscopic examination. The expert is also sometimes called upon to decide whether hair has been artificially colored or not, or has been bleached. This can generally be determined with certainty by microscopic examination and by simple chemical tests. The usual substances employed to color hair dark are mixtures containing salts of lead, bismuth, or silver, rarely of nickel; or, for very temporary coloring, lampblack mixed with fatty substances of some kind. In almost every case the microscope will show that the pigment is deposited on the surface of the hair, and that it has a very different appearance from the natural pigment. Moreover, it is almost always possible to find portions of the hair which have not been touched by the artificial color, and still retain their natural color. In such cases, the line of demarcation between the true and false color is very distinct; this is also true of hair that has been bleached with peroxide of hydrogen, or with chlorine water. If the artificial color on hair be due to a lead or bismuth compound, the resulting sulphide can be readily removed with a little dilute nitric acid; if due to a silver compound, a little nitric acid or chlorine water will remove the metallic silver deposited, while if a lampblack paste has been used, it can be washed off the hair. Bleached hair has a peculiar dirty yellowish-white appearance, which can almost always be detected by inspection, and it is more brittle than natural hair.

Downy hairs are free from color as well as from any medullary canal. The examination of downy hairs has proved of much importance in some legal cases, especially of infanticide or abortion, and their presence or absence may, in certain cases, throw some light as to the age of the fœtus. For instance, Gallard[1] in one case had submitted to him certain hairs for examination, to determine, if possible, the age of the fœtus from which they presumably came, since in that case no body could be found. He found that their diameter was greater than that of any of the fœtal body-hairs, and that they were probably head hairs of a fœtus from five to seven months, since the average diameter of the fœtal head-hairs, from the seventh to the ninth month, was from 0.028 mm. (1-907 in.) to 0.037 mm. (1-686 in.); that of a five-months fœtus, 0.024 mm. (1-1058 in.); and that of a three-months fœtus, 0.018 mm. (1-1411 in.). The average maximum diameter of the head-hair of an infant from one to twenty days old is the same as that of the seven to nine months fœtus. The hairs in question had a diameter of 0.024 mm. (1-1058 in.). During the ninth month of fœtal life most of the downy body-hairs fall out, and are suspended in the amniotic fluid, there being left only a few on the shoulders and thigh; hence the presence of downy hairs in the meconium of the new-born. Previous to the fifth month the fœtus has no downy body-hairs.

WERE THE HAIRS IN QUESTION PULLED OUT OR DID THEY FALL OUT SPONTANEOUSLY?

To decide this question an examination of the hair root must be made. As mentioned above (page 86), the root of a living, growing hair has a hollow space extending from below upward, into which the papilla projects; therefore, if we find in hairs submitted for examination this hollow open space, it shows that the hair was living and that it must have been pulled out. A hair, however, which has reached its growth and is ready to fall out has a root with a solid fibrous bottom. If we have such a hair for examination we cannot say whether it was pulled out or fell out spontaneously. Where a bunch of hairs is examined for the purpose of answering this question, the presence of a large number with the open root will show with great probability that the whole bunch was pulled out; if, however, nearly all of the hairs have the solid root, it will show that they were probably removed simply by combing or some gentle force, or fell out spontaneously.

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[1] Ann. d'Hyg., Oct., 1879, p. 371.

Were the Hairs Cut Off?—The absence of the root and the appearance of the end of the fragment toward the root will enable us to answer this question with certainty. As mentioned above, the direction of the scales of the cuticle will show which end of the fragment was toward the point and which toward the root, in case both ends of the fragment have the appearance of having been cut. If we have a large number of hairs to examine and nearly all of the cut ends show a clearly defined, cleanly cut section, it is probable that the hairs were cut with a sharp instrument; while if the ends are mostly jagged, with much irregularity in the projecting cortical fibres and cuticle scales, it is probable that a dull or a blunt instrument cut or broke the hairs off.

ABORTION AND INFANTICIDE.

BY

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ABORTION AND INFANTICIDE.

GENERAL CONSIDERATIONS.

MEDICO-LEGALLY, *abortion* means the premature expulsion of the product of conception, either as ovum, embryo, or fœtus. *Criminal abortion* means criminal interference with the course of gestation, so as to cause the premature expulsion of ovum, embryo, or fœtus. *Fœticide* means destroying the life of the fœtus before it is fully born and has a separate existence from its mother. *Infanticide* means destroying the life of a newly born child which has a separate existence from its mother. The overlapping of these terms leads to more or less confusion. Criminal abortion does not necessarily imply fœticide or infanticide; for if a viable child is born alive though premature, and no attempt is made upon its life after birth, criminal abortion may have taken place without either fœticide or infanticide. Then again fœticide or infanticide does not necessarily imply criminal abortion, for the premature expulsion of the fœtus may be due to natural causes, and criminal attempts may be made upon its life during or after its birth; or again criminal abortion may coexist with either fœticide or infanticide. Much confusion has arisen, too, from the different replies given to the question "Fœtus or child?" In a case of still-birth (asphyxia neonatorum), the child being completely born, its heart beating, but as yet no attempts at respiration—is the product of conception only a *fœtus* dependent upon its mother for life, or is it a separate being, an *infant* in the legal sense of the term? Prompt treatment might establish respiration and the child might live; delay or neglect might permit it to perish without having breathed. Would criminal action (whether active or passive) toward such a child be *fœticide* or *infanticide?*

Much popular confusion has arisen from erroneous notions respecting the time when life begins in the fœtus. Hippocrates made it the thirty-second day for the male, the forty-second for the female. Galen placed it at the fortieth day, while many held that the fœtus does not become a living creature till the hour of its birth.[1] The general opinion among the ancients seemed to be that the fœtus is a part of its mother until the time of its birth, when it acquires the nature and rights of a separate being. The mother had the same right to destroy it before birth as she would have to remove a tumor from her body. The Stoics taught that it received its soul with the establishment of respiration. The Justinian code fixed its animation at forty days after conception. In modern legislation, the human embryo is treated as a distinct being from the moment of conception, so that legally as well as physiologically life is postulated from the moment of impregnation.

Confusion has also arisen in some countries from different interpretations of the term *new-born*. How long may a child be considered new-born? When does the taking of its life cease to be infanticide and become murder? In 1824, Werner defined a child as *new-born*, so long as it is neither fed nor clad, while the mother still labors under the immediate consequences of delivery, and while no one but herself, her parents, and its father know of its birth. The Oldenburg statute-book[2] defines a new-born child as one not yet three days old. According to the old statute-book of Wurtemberg and Saxony, it is one not over twenty-four hours old. The present German and Austrian statutes define new-born as "in or immediately after birth" (German, in oder gleich nach der Geburt; Austrian, während oder gleich nach); the Italian as "un infante di recente nato." In France the law defines infanticide as the murder of a new-born child; and Ollivier says a child is new-born up to the fall of the cord (fifth to sixth day).[3] The question has not been raised in England.

Another question has been before the courts in Germany, which does not seem to have been raised in England or America: Can a *mole* be considered a product of conception, and can an accusation of criminal abortion hold in such a case?[4]

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[1] Lecky's "History of European Morals," 3d ed., vol. i., p. 92; *cf.* also vol. ii., pp. 20–28.

[2] Casper-Liman, Bd. ii., 8te Aufl., 878–9.

[3] Bouchut: "Maladies des Nouveau nés," 8th ed., p. 1.

[4] Casper-Liman, Bd. ii., 877–8. A hydatid mole is undoubtedly a degenerate product of conception, and its presence denotes the existence of pregnancy. Whether the law in this country would characterize the expulsion of a mole as abortion has not been determined.

ABORTION.

In considering a case of alleged abortion, four main questions suggest themselves:

1. Has abortion taken place?
2. If so, was it *spontaneous* (from natural causes), or *induced* (by the intentional act of the mother or any other person)?
3. If intentionally induced, was the act justifiable or criminal?
4. Did the induced abortion injure health or destroy life?

A fifth question may arise in some cases: Does the fact of non-pregnancy invalidate a charge of criminal abortion? Hofmann relates the case of a woman who was not pregnant, but believing herself to be so adopted means to procure an abortion. It was held that, although abortion could not take place in a non-pregnant woman, yet the penality of the attempt was not excluded, and the attempt was held punishable whether the completion of the act was possible or not.[1]

A case of this kind was tried a few years ago in Chicago. A girl died from metro-peritonitis, and a midwife was accused of causing her death by an attempt to induce abortion. The post-mortem showed that abortion had undoubtedly been attempted, but the girl had never been pregnant.[2]

DIAGNOSIS OF ABORTION.

The diagnosis of abortion is based upon:

1. The examination of the mother herself;
2. The examination of discharged matters,

and is generally easy if both methods of examination are available. Unfortunately, in most cases only the mother can be examined, and not until some time after the occurrence of the abortion. The relative ease or difficulty of diagnosis depends very much upon how soon and thoroughly the examination is made.

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[1] Hofmann, p. 218.

[2] Brit. Med. Jour., Sept. 16, 1882, p. 504.

EXAMINATION OF THE MOTHER.

The conditions present will depend upon the period of pregnancy, and the time which has elapsed since the abortion. In the earlier months, the appearances are seldom conclusive enough to warrant a positive diagnosis. Severe hemorrhage, the passage of large blood-clots, subsequent pallor and weakness may arouse suspicion, but may occur from so many other causes (*e.g.*, polypi, tumors, membranous dysmenorrhœa) that no positive conclusions can be drawn. The ovum is so small that the genital tract is not stretched or injured by its passage as in the later months. The further pregnancy advances, the larger the fœtus becomes and the more pronounced the stretching and wounding of the uterus and vagina by its extrusion. Abortions at the fourth to seventh month leave marks differing only in degree from those observed at full term, but fissures and lacerations of the os and cervix are proportionately rarer than after labor at full term. The changes in the hymen and the formation of carunculæ myrtiformes are not so well marked as at full term. If marks of instrumental or other violence can be made out, the probability of criminal interference is great. If the woman is dead and a careful post-mortem examination of the uterus and parturient canal can be made, the diagnosis is generally easy, provided putrefaction is not too far advanced.

If the accused denies pregnancy, it may be necessary to prove by the medical examination that pregnancy has existed recently, and that delivery has taken place either prematurely or at full term.[1] Or she may admit pregnancy, but claim that she was delivered naturally at full term or some time previously; it may then be necessary to establish the fact of premature delivery or recent delivery. Practically the difficulty of diagnosis is increased by the fact that most criminal abortions are induced in the first three months of pregnancy, when no definite or positive traces may be found, especially if the woman is alive and some days have elapsed since the abortion took place. The use of instruments by ignorant and unskilful persons is very apt to injure the parts, so that a careful examination made subsequently will reveal the existence of recent traumatisms or fresh cicatrices. But nowadays since the proper use of gynæcological instruments is so well understood even by the laity, instrumental abortion is commonly induced without leaving incriminating wounds. Dr. Resnikow,[1] a Russian physician, reports a case of abortion which he was called to attend in Odessa. The mother had borne three children. Three years previously she had successfully brought on abortion by passing a flexible rubber sound, and now for the second time she had resorted to similar means. When seven or eight weeks pregnant, she began passing a sound into her uterus every day; finally she left it *in situ* till pains set in and then removed it. She used a No. 16 sound, and disinfected it carefully in two-per-cent carbolic acid solution each time before passing it. She said she had learned how to pass it from a midwife, and showed Dr. R. how she did it. In this case it would have been impossible to determine by physical examination whether the abortion was natural or artificial.

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[1] See PREGNANCY, LABOR, etc., this vol., pp. 261–379.

Goenner has just reported a remarkable case of self-induced abortion. A multipara æt. 37, two months pregnant, passed an elastic catheter, whose anterior half had been cut off, into the vagina by means of the stylet. She suddenly felt pain, and thinking that the catheter had entered the cervix, withdrew the stylet. Some blood flowed, and symptoms of fever and peritonitis soon began. She aborted six days afterward, but the catheter did not come away nor could it be found. A couple of months later it was passed from the bowel, coated over with mucus. The question is whether the catheter entered the uterus or abdominal cavity, and how it managed to get into the intestinal canal. The patient was a married woman, and there was no attempt at concealment. She had already succeeded on three previous occasions in procuring abortion with a similar instrument, and when she found that something was wrong immediately sought advice and was under observation throughout.[2]

EXAMINATION OF DISCHARGED MATTERS.

If all clots and discharges have been saved, and can be examined within a few days of their discharge, there should be little difficulty in determining the presence of an ovum or ovular structure. The older the ovum, the easier is its detection. All clots should be examined under water; the blood is thereby washed away and a complete ovum sometimes found. In the first two or three months it is frequently expelled entire; but after the formation of the placenta the membranes usually rupture, the embryo is expelled, and the placenta comes away subsequently (hours, days, or even weeks).

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[1] Centralblatt f. Gyn., No. 44, 1893, p. 1,016. [2] *Ibid.*, No. 3, 1894, p. 68.

Finding the embryo is not essential for the diagnosis of pregnancy or abortion; any of the distinctly fœtal structures suffice, such as the placenta, amnion, chorion, or chorionic villi. The decidua being a maternal structure is not positively diagnostic, because it is not always distinguishable from a menstrual or pathological decidua of the non-pregnant state. If portions of membrane only are available, they should be examined microscopically; a simple macroscopic examination is open to many fallacies and is, therefore, untrustworthy. If the complete ovum can be examined, an idea may be formed of the age of the embryo and the period of gestation. Such an idea, however, is only approximate, as the embryo may have perished some time before it was expelled. Indeed it is possible for the embryo in the first two months to perish and be absorbed.

Again, disease of the fœtal or maternal structures may arrest or pervert the growth of the ovum, so that no satisfactory conclusion can be drawn from the size or appearance of the embryo as to the period of pregnancy. In such cases, however, the maternal or fœtal structures will show evidences of disease which are easily recognizable. A healthy ovum in healthy surroundings will follow the ordinary plan of development; it is only the unhealthy ovum in unhealthy surroundings which varies from the normal type, and the microscope readily enables us to detect the pathological conditions which caused the variation.

In exceptional cases the fœtus perishes and remains quite fresh in the uterus for weeks or even months, until it is finally discharged. A remarkable case in this connection is that of Liégey,[1] where a woman claimed on this ground that a six-months fœtus belonged to her eleven-months-dead husband. If an ovum has been lying for some time in earth or water (as in a closet or privy), or if decomposition is far advanced, it may be difficult to form an opinion respecting its age. Minute descriptions of the appearance of the ovum at the various periods of its growth can be found in any of the recent works on embryology; it will suffice here to give very briefly the size of the embryo at the various months.[1]

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[1] Virchow, Jahrb., 1881, i., 533. Consult also articles on *missed abortion* and *concealed abortion* in the larger obstetrical works.

At end of **First month:**[2] Ovum size of pigeon's egg, 1.7–2 cm. long; chorionic villi equally distributed over the whole surface. Embryo 1 cm. long; attached to chorion with a very short cord; strongly curved; nose and mouth form a single cavity; umbilical vesicle still present; extremities evident as buds or small excrescences.

Second month (eighth week): Ovum size of hen's egg. Embryo 2.5–3 cm. long; weighs 4 grammes. No longer curved; cavities of mouth and nose separated; umbilical vesicle disappeared; extremities developed but not fingers and toes; cord longer; ossification begun in lower jaw, clavicle, ribs, and bodies of vertebræ.

Third month (twelfth week): Ovum size of goose-egg. Placenta developed. Fœtus 7–9 cm. long, weighs 5–30 grammes. Fingers and toes developed; sex begins to differentiate; ossification in cranial bones and diaphyses of the extremities; average weight of placenta, 36 grammes; average length of cord, 7 cm.

Fourth month (sixteenth week): Fœtus 10–17 cm. long, weighs 43–120 grammes; sex differentiated; hair and nails begin to appear; average weight of placenta, 80 grammes; average length of cord, 19 cm.

Fifth month (twentieth week): Fœtus 18–27 cm. long, weighs 225–320 grammes; skin bright red and thin; meconium appears, colored with bile; average weight of placenta, 178 grammes; average length of cord, 31 cm.; point of insertion of cord, which was in the earlier months near the symphysis, begins to recede upward.

Sixth month (twenty-fourth week): Fœtus 28–34 cm. long, weighs 634 grammes (average); head not so relatively large as in earlier months; skin thicker and panniculus adiposus begins to develop; hair more abundant; vernix appears; testicles still in abdominal cavity; labia majora as yet slightly developed; labia minora and clitoris projecting between them; pupillary membrane still present; weight of placenta, 273 grammes; cord, 37 cm. long, and its insertion farther from symphysis.

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[1] For signs of maturity of fœtus, especially its weight and measurements, consult Hecker, Monatschr. f. Geb., 1866, xxvii., 266; Casper-Liman, ii., p. 887; Toldt, Prag. Med. Woch., 189, 121; Schroeder's "Lehrb. d. Geburtsh.," 1888, pp. 58–61; Winckel's "Lehrb. d. Geb.," 1889, pp. 29–32; Vibert's "Précis de Méd. Lèg.," 1893, p. 388.

[2] This table is abridged from Hofmann's "Lehrbuch der gerichtl. Medicin," p. 222. Compare Casper-Liman, ii., p. 884; also Barnes, Playfair, Parvin, etc.

Seventh month (twenty-eighth week): Fœtus 35–38 cm. long, weighs 1,218 grammes (average); hair of head is 5–6 mm. long; skin still red and thin; testicles begin to descend; cerebral convolutions begin to form; pupillary membrane often shows signs of disappearance toward the twenty-eighth week; a centre of ossification 2–5 mm. wide in os calcis—it can be made out in the second half of the sixth month; average weight of placenta, 374 grammes; average length of cord, 42 cm.

Eighth month (thirty-second week): Is the most important from a forensic point of view, because viability begins at end of thirtieth week (210th day). Fœtus 39–41.5 cm. long, weighs 1,500–2,500 grammes. Nails almost to end of fingers; ossification begins in last sacral vertebra; pupillary membrane gone; testicles in scrotum or inguinal canal; ossification centre in astragalus.

Ninth month (thirty-sixth week): Fœtus 44.2–46 cm. long and weighs 2,000–3,000 grammes; scrotum begins to wrinkle and vulva to close.

Signs of Maturity.—Fœtus 46–51 cm. long (18–20 inches), weighs 2,270–3,500 grammes (5–7 lbs.); males are generally longer and heavier than females; the head is large, being nearly one-fourth of the total length; skin pale, and nails reaching to the ends of the fingers; external auricle measures 2½–4 cm. long, 2–2½ cm. broad, and varies but little in children of different sizes; the point of ossification in the lower epiphysis of the femur appears about the thirty-sixth or thirty-seventh week, and at full term is 7–8 mm. in diameter; features perfect, hair abundant on head, body well developed.

Children vary greatly in size, weight, and development even when they have reached maturity; although the average weight is from six to seven pounds, yet a mature child may weigh as low as one pound or as high as twenty-eight and three-quarters pounds.[1] It would, therefore, be impossible in any given case to determine positively by weight or measurement whether a child is fully mature or not. The general development is a safer guide than weight and measurement, and it is better to affirm maturity only when the majority of the appearances found in mature children are present. It is better to err on the side of caution when giving a positive opinion regarding the maturity of new-born children.[1] (See also PREGNANCY, etc., Vol. II., pp. 291–295.)

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[1] Parvin's "Obstetrics," 2d ed., p. 151.

WAS THE ABORTION SPONTANEOUS OR INDUCED?

When it has been made out that abortion has actually taken place, the next point to determine is, whether it was due to natural causes or was artificially induced.

NATURAL ABORTION.

Spontaneous abortion occurs more frequently than is generally supposed. Auvard states that probably there are as many abortions and premature confinements as labors at full term.[2] Hegar estimates that there is one abortion in the first month of pregnancy to every eight or ten full-term births.[3]

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[1] WEIGHTS OF FŒTUS IN GRAMMES.

	Hofmann.	Schroeder.	Winckel.	Spiegelberg.	Ahlfeld.
At end of first month (4th week)					
" second month (8th week)..	4				
" third month (12th week)....	5–20	5–20	up to 20	30	
" fourth month (16th week)..	up to 120	up to 120	43–117	55	
" fifth month (20th week)....	225–320	284 (av.)	139–350 (av.250–275)	273	
" sixth month (24th week)...	634 (av.)	634 (av.)	432–950 (700 av.)	676	
" seventh month (28th week).	1,218 (av.)	1,218 (av.)	820–1,155	1,170	1,635 (av.)
" eighth month (32d week)...	1,500–2,500	1,900 (av.)	1,335–1,615	1,571	2,107 (av.)
" ninth month (36th week)...	3,000 (av.)	2,500 (av.)	2,188–2,684	1,942	2,806 (av.)
" tenth month (40th week)...	3,000–3,500	3,100 (av.)	3,100–3,600	2,323	3,168 (av.)

Charpentier makes the weight of mature fœtus 3,000–3,500, but adds that it may be as low as 2,000—below 2,000 he would call it immature. Vibert makes weight at maturity 3,000–3,500. Tardieu gives a table of the weights of 4,104 infants born at term at the Maternity, Paris. The higest was 5,300 and the lowest 2,000 grammes; more than half weighed between 3,000 and 3,500 grammes. In commenting upon his statistics he says that we must admit that occasionally a child weighing 1,200 to 1,500 may be at term; but that if it weighs 3,000 it must be.

[2] Auvard: "Traité d'Accouchements," p. 561.

[3] Schroeder: "Geburtshilfe," 10th ed., p. 460.

Some authorities claim that very few fruitful married women pass through the child-bearing period without aborting.

During the first six weeks the ovum is very loosely attached to the uterus, and is easily separated and cast off. The uterus is then more sensitive to injury or irritation, and the woman, probably unaware of her condition, takes less care to avoid causes of excitement or irritation.

Abortion is also common from the twelfth to the sixteenth week, while arrangements for the placental nourishment of the fœtus are being perfected. Hofmann states that in his experience the sixth to the seventh month is the time when a macerated fœtus is usually expelled, and that the period of commencing viability is a critical time for the fœtus.

The actual cause of a spontaneous abortion may be traced to the ovum or the mother. Diseases of the embryo or the fœtal membranes may predispose to or determine abortion; in medico-legal cases it is important to remember such causes and exclude them if possible. Some women abort more easily than others, and more easily at one time than another. Some abort on the slightest provocation, while others may be subjected to great violence without disturbing the course of gestation. In one case a pregnant woman fell from a two-story window and broke both legs, but did not abort; while it often happens that a misstep or sudden jar, a long walk, a ride in a carriage, or the use of the sewing-machine may suffice to produce hemorrhage and abortion. The ease or difficulty with which the ovum is detached or destroyed depends in great measure upon the healthiness or unhealthiness of the ovum and uterus; the health and environment of the pregnant woman are, therefore, important factors in such cases. Other things being equal, weakness, irritability, emotional excitement, and general ill-health facilitate abortion; it is, therefore, easy to understand why some women abort more readily than others, why the same woman aborts more readily in one pregnancy than another, and why abortion is so easy to induce in some, so difficult and dangerous in others. As a general rule a healthy ovum adheres with great tenacity to a healthy uterus; the ovum is not at the hazard of every gust of passion or emotion, and it is safe to conclude that when the attachments are easily broken up, there has been some unhealthy condition of the ovum or its environment.

A legal point might arise as to whether a well-known habit of aborting might be alleged as a defence in a charge of criminal abortion. For example, some abortifacient drug (as ergot) may have been taken in moderate amount or in doses usually insufficient to produce abortion, nevertheless the woman aborts; would the smallness of the dose be a good defence, if it can be proved that the woman was in the habit of aborting easily? The medical witness should bear this in mind, and ascertain the woman's previous history as to the ease, habit, or frequency of abortion.

It has already been stated, that in abortions after the third month the fœtus usually comes away first, and then after a variable time the placenta and membranes are peeled off and expelled. Hours, days, weeks, or even months may elapse before the abortion is complete. Exceptionally the placenta may remain attached to the uterus and live or even grow (though this last has been recently disputed). In Jakob's case,[1] the woman aborted in the fourth month, but the placenta remained for seven months longer and finally came away as a hard mass without odor or signs of decomposition. Similar cases[2] have been reported by McClintock, Fairbank, Roth, Depaul, and others.

It may occasionally happen that the fœtus may be expelled from the uterus some days after the mother's death by the pressure of putrefactive gases. Ebertz reports the case of a primipara, æt. 20, in the ninth month of pregnancy, who suddenly developed suspicious symptoms (poisoning?), and died. On the third day afterward the fœtus in its membranes was expelled. The uterus, inverted, and its internal surface, with placenta attached, came through the vulva. The weather was very hot, and decomposition was rapid. The remarkable point is that there was no sign of labor during life, and no sign of abortion until three days after death. Theopold reports another remarkable case. The body of a woman who had died from hemorrhage during the later months of pregnancy was exhumed for examination on the fourteenth day after death. The weather was warm, and while the post-mortem was being made the head, enveloped in the membranes, suddenly emerged from the vulva. The fatal hemorrhage was due to premature

[1] Virchow's Jahrb., 1881, ii., p. 562.

[2] Hofmann, p. 227.

separation of the placenta, and there were no signs of instrumental interference.[1] (See also POST-MORTEM BIRTH, Vol. II., pp. 369–379.)

Abortion is usually more dangerous to the mother than delivery at full term, chiefly from hemorrhage and septic infection. Severe hemorrhage may occur at the time of abortion; or if portions of placenta and membranes are retained, there may be recurrent attacks leading finally to fatal exhaustion. Sepsis occurs when pus-producing micro-organisms invade the retained matters and their poisonous products are absorbed. Such pus-producing bacteria must be introduced from without, generally by means of unclean hands, instruments, or dressings, rarely, perhaps, by impure air. The more the parturient canal is injured, the greater the risk of absorption and septic infection. It is evident, therefore, that such accidents are more liable to happen when abortion has been provoked than when it is due to natural causes.

The following table by Barnes[2] gives a very good summary of the causes of natural abortion:

Maternal Causes.—I. POISONS IN MOTHER'S BLOOD.

(1) Communicated. *Heterogenetic:* Fevers, malaria, syphilis.
Gases, as CO, CO_2.
Minerals: lead, copper, mercury.
Vegetable substances: ergot, savin.

(2) Products of morbid action. *Autogenetic:* as in jaundice, albuminuria, CO_2 from asphyxia, and in the moribund.

(3) Anæmia, over-suckling, obstinate vomiting.
Bright's disease, lithiasis, jaundice.

II. DISEASES DISTURBING THE CIRCULATION DYNAMICALLY.
Some liver diseases, obstructing portal system.
Heart diseases, excess of vascular tension.
Lung diseases, thoracic and abdominal tumors.

III. CAUSES ACTING THROUGH THE NERVOUS SYSTEM.
Some nervous diseases.
Shock, physical and psychical.

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[1] Vierteljahrsch. f. ger. Med., xlvii., 171.

[2] Barnes: "System of Obstet. Med. and Surgery," Amer. ed., p. 350.

Diversion or exhaustion of nerve force, as from vomiting.
Reflex action.
Convulsion, apoplexy (these last two act partly through asphyxia, producing CO_2 in the blood).

IV. LOCAL OR PELVIC DISEASE.
Of uterus, as inflammation, hypertrophy, tumors, diseases of decidua.
Mechanical anomalies, as flexions and versions of uterus, fissures of cervix, pressure of tumors on uterus, or adhesions of uterus preventing its growth.

V. ADOLESCENT AND CLIMACTERIC ABORTION.
Uterus immature (infantile) or
Uterus in atrophic involution (senile).

VI. ARTIFICIALLY CAUSED BY VIOLENCE.
Blows, squeezing, puncture of uterus, injury to ovum.
Epidemic Abortion.
Sympathetic Abortion.

Fœtal Causes.—I. DISEASES OF OVUM.
Primary or secondary upon diseases of maternal structures or blood.

II. DISEASES OF EMBRYO, GENERALLY CAUSING ITS PREMATURE DEATH.
Faults of development.
Diseases of nervous system.
Diseases of kidney.
Diseases of liver.
Diseases, general, as syphilis.
Mechanical, as torsion of cord, or anything causing death of embryo.

If we can exclude natural causes, we are justified in concluding that abortion was induced.

WAS THE INDUCTION OF ABORTION JUSTIFIABLE?

A full review of the conditions which justify the induction of abortion or premature labor may be found in any of the larger text-books on obstetrics.[1] In general terms it may be said that the induction of abortion is justifiable—

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[1] See Hirst's "System of Obstetrics," ii., pp. 195-200.

(1) Whenever there is such mechanical obstruction that the birth of a viable child is impossible.

(2) Whenever the mother is suffering from such grave disease that her life is in imminent peril and can be saved only by the arrest of gestation.

The induction of premature labor is indicated when, from disease or pelvic deformity, the further continuance of pregnancy, or labor at full term, would expose mother or child to serious risks which might be diminished or avoided by the artificial arrest of gestation.

While the law does not formally recognize the right of a physician to provoke labor, yet the judges have always held that a physician is morally justified in interfering to save the life of mother or child which would be jeopardized or lost if nature were allowed to take its course; just as surgical operations are held to be justifiable, although no exception is made in their favor in the statute on wounding. A physician is as much justified in inducing abortion in suitable cases, as in amputating a limb or removing a cancerous uterus or breast, or doing an ovariotomy. Physicians should not undertake to arrest gestation, especially when the child is not viable and must perish as the result of the operation, without careful and serious consideration, preferably after consultation with a *confrère*, and always with the consent of the relatives duly attested.

CRIMINAL ABORTION.

If it can be shown that abortion was not due to natural causes but was caused by interference, and if such interference was not undertaken by a competent medical practitioner for sufficient cause, the case is narrowed down to one of criminal abortion. The English law[1] reads as follows:

> "58. Every woman, being with child, who, with intent to procure her own miscarriage, shall unlawfully administer to herself any poison, or other noxious thing, or shall unlawfully use any instrument, or other means whatsoever, with like intent, and whosoever, with intent to procure the miscarriage of any woman, whether she be or be not with child, shall unlawfully administer, etc., shall be guilty of felony.

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[1] 24 and 25 Vict., cap. 100, sects. 58–59.

"59. Whosoever shall unlawfully supply or procure any poison, or other noxious thing, or any instrument or thing whatsoever, knowing that the same is intended to be unlawfully used or employed with intent to procure the miscarriage of any woman, whether she be or be not with child, shall be guilty of a misdemeanor, and, being convicted thereof, shall be liable, at the discretion of the court, to be kept in penal servitude for the term of three years, or to be imprisoned for any term not exceeding two years."

The French, German, and Austrian laws are similar.

It is obvious, therefore, that if a person tries to commit abortion on a woman, or aid her in doing so, that person has committed a criminal offense, no matter whether the woman is really pregnant or not, whether the child is living or not, whether it is viable or not, whether it is deformed or a monster, whether the measures used (medicinal, mechanical, or instrumental) are effectual or not, or whether temporary or permanent injury has been done to the woman by the means used for that purpose. Nor does the consent or solicitation of the woman extenuate the criminality of the procurer. But from the very nature of the case, the woman must be almost invariably accessory to the abortion produced upon herself,[1] and the evidence of an accomplice if unsupported and uncorroborated is regarded with distrust. The late Fitz-James Stephen says: "When the only proof against a person charged with a criminal offence, is the evidence of an accomplice, uncorroborated in any material particular, it is the duty of the judge to warn the jury that it is unsafe to convict anybody on such evidence, although they have a legal right to do so." This is a great practical difficulty in securing the conviction of abortionists. The ignorance and unskilfulness of such persons increase the risks to which their victims are exposed. Most drugs used as abortifacients are violent irritants, and produce their effect mainly by causing intense irritation of the pelvic viscera; they are given in large doses, the effect of which is not unfrequently poisoning or grave abdominal or pelvic inflammation. If the woman's life is not sacrificed, her health is often shattered and irreparable damage done. When instruments are used to produce abortion, the ignorance or unskilfulness of the operator or the neglect of the necessary antiseptic precautions exposes the woman to serious risks from hemorrhage, inflammation, or septic absorption. If death results, the English law holds the operator guilty of murder, even though the operation was done at the request or with the consent of the woman, and without any intention of doing her permanent or serious bodily harm. The crime might be reduced to manslaughter provided the drug or instrument was not dangerous and was not used to destroy life, although employed for an unlawful purpose.[1]

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[1] If the woman is chloroformed or under the influence of liquor, or in any way rendered unconscious of what is being done, she cannot be an accessory, provided always she was unaware previously of what was to be attempted.

Clark Bell[2] says that according to the law in the United States, any person who does any act calculated to prevent a child being born alive, is guilty of abortion; that if death ensues in consequence of the means employed for this purpose the offence is murder at common law, though in some States it has been declared to be manslaughter; that the intention constitutes the crime, not the means employed.

Some confusion has arisen from the different interpretations given to the term "*noxious thing*" in the statute. What constitutes a noxious thing? Does the noxiousness consist in the thing itself, in the dose in which it was given, or in the circumstances of its administration? A single dose may not be noxious, but several doses given within a short time may be. One preparation of a drug may be comparatively harmless, another may be noxious. A drug administered to a non-pregnant woman may not be noxious, but may become so when given to a pregnant woman. The drug may or may not be injurious in itself; but if the dose given in a certain case was injurious under the particular circumstances, it was noxious in that case.

It was held in England[3] (R. *v.* Cramp) "that in such case it was a question for the jury to say whether the substance, administered as it was, and under the circumstances in which it was administered, was a noxious thing. Therefore neither principle nor authority precludes us from holding what is certainly good sense—that if a person administer, with intent to produce miscarriage, something which as administered is noxious, he administers a noxious thing." The statute makes it penal to administer any poison or other noxious thing, or to unlawfully use any instrument *or other means whatsoever* to produce abortion. It does not, therefore, seem necessary to prove the noxiousness of the drug employed, any *other means whatsoever* employed for the same purpose would be equally criminal. Such an interpretation is more in accord with the dictates of common sense as well as with the obvious intention of the law, and would greatly simplify medical evidence in cases of criminal abortion.

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[1] R. v. Stadtmühler (Liverpool winter assizes, 1858); quoted by Tidy.

[2] Taylor's "Med. Jurisp.," 11th Am. ed., p. 526; Clark Bell, the American editor, refers to a number of American decisions, illustrating various interpretations of the law as laid down in different States of the Union.

[3] Med. Times and Gazette, March 6th, 1880; Dec. 25th, 1880, quoted by Tidy.

If a woman attempt to produce abortion upon herself without the assistance of others, the law makes the existence of pregnancy material to the charge[1] (Tidy).

MEASURES USED TO PRODUCE ABORTION.

The practice of abortion is common among savage and semi-civilized nations as well as among the most civilized. The ruder the nation, the rougher and more primitive are the means employed. Among the lower classes, we find many household remedies (folk-medicines, so to speak) which were used as abortifacients by the physicians of earlier days, and many of the manipulations and operations now in use have been practised since ancient times. In the ruder civilizations the materia medica is very simple, being chiefly confined to the plants familiar to them; hence the abortifacients used by them consist chiefly of decoctions or infusions of various indigenous roots and herbs. As Great Britain and America have been for years havens of refuge for the poor and oppressed of all nations, we find among the lower classes of our population many of the popular notions and superstitions of other countries engrafted upon our own. Hence we must be prepared to find in use not only those things which modern medicine would indicate as likely to have abortifacient action, but also a number of crude preparations and methods imported from other lands. The means adopted for procuring abortion may be divided into three classes:

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[1] Report of the New York Medico-Legal Society on criminal abortion (New York Medical Jour., xv., p. 77).

1. Drugs and other matters given internally.
2. General measures, which do not excite suspicion and are usually hard to detect and prove.
3. Local measures, in the form of direct interference with the ovum, uterus, and parturient canal.

I. **Internal Remedies** are by far the most frequent means used among the common people, and are generally administered in the form of decoctions or infusions of various roots and leaves, which have strong aromatic properties. As a rule, their abortive action is slight or none at all, although some do seem to have more or less effect upon the uterine muscle. The popular belief in their efficacy seems to come from a sort of *post hoc, propter hoc* reasoning. A pregnant woman, or one who believes herself to be so, takes a certain potion to bring on her courses; in due time she aborts, or her courses reappear, and thenceforth she is a firm believer in the efficacy of that potion, and hastens to tell the good news to her friends. From the earliest times certain drugs have been supposed to have abortifacient power, and their action has been attributed to a specific effect upon the uterus. In the great majority of cases, however, they act indirectly by causing profound excitement of the neighboring viscera and disturbing the functions of kidney, bladder, or rectum. Thus diuretics, purgatives, emetics, and various toxic drugs in large and irritating doses are employed as abortifacients quite as commonly as the so-called ecbolics. The success of such drugs depends in great measure upon the health and individual peculiarities of the woman herself. If she aborts readily, almost anything which produces great constitutional disturbance or pelvic irritation will succeed. If the attachments between the uterus and ovum are strong, the drug may require to be pushed to dangerous or even fatal doses, and even then death may occur without abortion having taken place This accounts for the great diversity of opinion respecting the abortifacient value of different drugs, and the great number of them which are used for that purpose.

DIURETICS have only feeble powers and generally fail. PURGATIVES which act upon the lower bowel may indirectly excite the uterus to action; the favorites are aloes, croton oil, jalap, gamboge, and elaterium. EMETICS, particularly of the depressant type, are apt to succeed in the later months. Tartaric emetic is the commonest and most effectual. ECBOLICS are supposed to have a direct effect upon the uterus itself, exciting it to vigorous contraction; the only one which is worthy of the name is ergot. EMMENAGOGUES, used to promote or excite the menstrual discharge, have little power as abortifacients unless taken in large and frequently repeated doses, when they act as drastics or stimulating diuretics, and thus indirectly excite the uterus to contract and expel its contents. TOXIC AGENTS, animal, mineral, or vegetable, may produce abortion in those who are predisposed, on account of the general constitutional disturbance they set up; the abortion is only one of the symptoms of the poisoning. They may act by destroying the fœtus, or indirectly exciting the uterus to contract.

Gastro-intestinal inflammation is usually more extensive and severe after criminal abortion than after natural miscarriage, and congestion of the kidney is generally found if abortifacient drugs have been used.

A few of the drugs most commonly used as abortifacients will now be considered in detail.

METALS AND THEIR SALTS.—*Iron.*—The sulphate and perchloride are the only salts which may produce ill effects by causing irritation. The dose must be very large to do any harm. Iron is given freely to pregnant as well as non-pregnant women for the cure of anæmia, without ill effect. While many cases have been recorded where iron has failed when given as an abortifacient, none has been reported where it has succeeded.

Mercury in the metallic form is useless as an abortive. Mercury in the form of calomel, corrosive sublimate, the iodides, administered by the mouth, inunction, vapor, or hypodermic injection, may be used as freely by the pregnant as the non-pregnant in medicinal doses. When pushed so as to produce severe salivation, it might cause abortion in those predisposed.

Arsenic is not an abortifacient. Taylor records a case where a woman in the fifth month of pregnancy took a large dose of arsenic to produce abortion; she vomited and purged severely, and died in seven hours, but did not abort. A girl of seventeen swallowed a package of insect poison, had severe symptoms of poisoning, but finally recovered and went on to full term.

Potassium.—The iodide in medicinal doses has no ill effect. The nitrate is reported in one case to have caused abortion.

Sodium.—The biborate (borax) is commonly credited with abortifacient properties; there is no evidence to support this opinion.

Phosphorus.— Used extensively on the Continent. The heads of lucifer matches are soaked in water or scraped off. A large number of the cases end fataly.

Lead.—White-lead has been occasionally used. Freyer[1] reports a case in which 45 grammes of white-lead had been administered for the purpose of criminal abortion with fatal results. The same person had succeeded previously in producing abortion with white-lead in a woman four months pregnant. Pope[2] reported two fatal cases recently of self-administration of diachylon plaster as an abortive. Both complained of abdominal pain and tenderness and lost or weakened reflexes; there was a blue line on the gums. In both a spasm was observed shortly before death; one died from coma, the other from paralysis of the diaphragm. In one the post-mortem showed no trace of lead, but incineration of one kidney demonstrated its presence. In the other, the skin and conjunctivæ were yellowish, and the intestine was contracted and contained a yellow sticky fluid.

VEGETABLE PREPARATIONS.—*Savin* (Juniperus sabina), an irritant poison, whose active principle is an ethereal oil, with terebinthinate odor. A decoction or infusion of the leaves is a popular abortifacient potion; the oil or tincture is occasionally given. It has a powerful effect upon the genito-urinary system, and causes hæmaturia in animals. The odor is easily detected in the urine. Though dangerous to life when administered in large or frequently repeated doses, its abortifacient action seems to be uncertain. Abortion accompanied with violent flooding usually precedes death. Post-mortem, there are evidences of gastro-intestinal inflammation, and the peculiar odor of the oil is generally found in the blood and body cavities. The contents of the stomach will be green, like pea-soup, if the poison has been taken as powder or decoction.

Rue (Ruta graveolens) is used in the form of a decoction of the plant and seeds. Its action is similar to that of savin but is less decided. Tardieu mentions three cases in which it produced abortion in fourth, fifth, and sixth month respectively, the woman recovering. Wood[1] says that he is not aware of any case where death followed the use of rue as an abortifacient, and the only fatal case recorded was that of a man weakened by dysentery.[2] Rue acts most powerfully when fresh.

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[1] Zeitsch. f. medic. Beamte, 1888, 231.

[2] Brit. Med. Journal, July 1st, 1893, p. 9.

Pennyroyal (Mentha pulegium). Used popularly in the form of infusion, as an emmenagogue and ecbolic, but has no more effect on the uterus than other varieties of mint.

Tansy (Tenacetum) is used largely throughout the United States as an abortifacient, in the form of decoction or oil. It is unsafe and is liable to produce violent abdominal pain, vomiting, epileptiform convulsions, and even death;[3] ʒ i. of the oil has proved fatal. It acts primarily on the spinal cord; small doses may produce numbness and pricking of the extremities or dilatation or immobility of the pupils, or convulsions in the highly nervous. Profuse salivation has been observed.

Gossypium, the root of the cotton-wood plant, is used in decoction by the negroes throughout the South, as an abortifacient. It is supposed to resemble ergot in its action.

Pilocarpin.—Gigeollet[4] has induced abortion by the hypodermic injection of this drug, and experiments upon animals have proved that uterine contractions may be caused either by hypodermic or intravenous injections.[5] It acts indirectly by lowering the patient's strength.[6] In large doses it is a very dangerous drug, especially for pregnant women. Its depressant action upon the heart may cause alarming symptoms. A fatal case has come under my own observation.

Saffron (Crocus sativus) in decoction is a popular abortive. It has not been proved to have any such action.

Yew (Taxus baccata) is said to have been used successfully in producing abortion.

Actea racemosa (black cohosh—squaw-root) has occasionally succeeded.

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[1] H. C. Wood's "Therapeutics," 8th ed., p. 806.

[2] Dr. G. F. Cooper, in Med. Examiner U. S., ix., 720.

[3] See United States Dispensatory for record of fatal cases, most of which have been in America.

[4] Hofmann, p. 233; *cf.* also Schauta's "Geburtshilfe," 1885, p. 48.

[5] Virchow's Jahrbuch, 1881, i., 455.

[6] London Medical Record, Jan., 1879.

Hellebore (Helleborus niger) is a hydragogue cathartic and emmenagogue. It is active and largely used in the United States. Large doses give numerous painful fluid motions almost always accompanied by vomiting, tenesmus, heat through the hips, and bearing down. There is usually a pricking sensation in the tongue, fauces, and throat, with a feeling of constriction and epigastric pain. There is sometimes coldness of the extremities, with cold clammy perspiration. The pulse may fall to 50 or even to 30 beats per minute.

Tobacco is said to have abortifacient properties. Rocks investigated its effects among girls working in a tobacco factory. The evidence is not sufficient to warrant a positive conclusion.

Ergot of Rye (Secale cornutum) is a fungous growth on the grain of rye. It is commonly used in medicine as powder, tincture, or fluid extract, or in the form of a watery extract (ergotin). It is a very complex substance, and it is not yet settled what its active principle really is, the views of different chemists being very conflicting upon this point. It undoubtedly acts upon unstriped muscle and stimulates the uterus to tonic contraction. Hemmeter's observations prove that it may cause uterine action by stimulating the centres in the lumbar portion of the cord. It is still a matter of dispute whether its action upon the uterus is centric in origin or peripheral.[1] In small doses it aids and strengthens normal uterine contraction; in large doses it causes unyielding uterine spasm which drives all before it. Wood says that it has sometimes produced fatal abortion, but that he knows of only two cases of decided poisoning in non-pregnant women. When it does poison, the symptoms are mainly paralytic. It is less likely to cause death after a single large dose than if taken in smaller doses for some time. Tardieu reports the case of a woman, æt. 24, who aborted in the fourth month of pregnancy, after taking a dose of ergot in powder, and died of peritonitis in twenty-four hours; fragments of ergot were found in the lower bowel. In doses of 15 grains, it has produced nausea, vomiting, epigastric uneasiness, a sensation of fulness in the stomach developing afterward into pain. In large doses (ʒ ij.) it produced, in addition to these symptoms, dryness of throat, dizziness, dilatation of the pupils, abdominal pain, slowing of pulse, and finally delirium, coma, and death. Ergotin in doses of 3 to 8 grains has slowed the pulse to 18–12 beats per minute (Schroff). Besides its action upon the uterine muscle, ergot depresses the fœtal circulation and may thus produce abortion indirectly. It is still a matter of dispute whether ergot can originate uterine contraction, although it is admitted by all observers that it can intensify uterine action when once begun. It seems to be fairly well established that it may originate uterine contractions in a certain percentage of cases. Hofmann says that in 47 cases of premature labor in which ergot was employed, it succeeded without other measures in 32 cases. It has, therefore, true ecbolic properties, but is not certain in its action. This uncertainty has been attributed to the varying strength or freshness of the preparations employed, failure being due to inertness of the sample. Experience goes to prove that its abortive action is uncertain in small and safe doses, and that if labor is to be induced, it must be given in such large doses that there is danger of poisoning. Richter[1] records a fatal case: a woman, æt. 22, strong, in sixth or seventh month, had vomiting and great thirst for two days before being seen by a physician. He found her conscious, pale, very restless, with quick pulse, great thirst, pain in stomach and bowels, and retention of urine. Labor was going on and soon ended in the birth of a recently dead child. Half an hour afterward the mother died with profuse hemorrhage. Post-mortem appearances were great anæmia, slight injection of stomach, hemorrhage, erosions at the fundus and on the greater curvature, chocolate color of stomach-contents, and red streaks in the œsophagus. The poison could not be fully made out. When ergot has been given in powder and the case terminates fatally, fragments may usually be found in the intestine and recognized by their microscopic appearances, as well as by the fishy odor evolved when rubbed up with a solution of potash. When the tincture or fluid extract has been given, the recognition of the poison is difficult or impossible. And if ergotin has been administered hypodermically it is still more difficult to detect. The medical expert must not forget the possibility of the hypodermic method of administration in such cases.

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[1] Wood's "Therapeutics," 8th ed., p. 818; a full statement of the different views regarding the action of ergot is given, together with a number of references. The article is a good *résumé* of the present state of knowledge regarding ergot and its action.

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[1] Vierteljahrschr. f. ger. u. öff. Med., Berlin, 1861, xx., 177–233.

It will thus be seen that most so-called abortives are very uncertain in their action, that ergot is the only drug with true ecbolic power, and that when abortion follows the use of other drugs, the effect is attributable to the systemic disturbance caused by general poisoning rather than to any specific or primary effect upon the uterine muscle or lumbar centres. Thus any poison may become an abortifacient, the destruction of the fœtus or its expulsion from the uterus being one of the train of symptoms resulting from general systemic poisoning.

No doubt in many cases of poisoning the primary object has been to produce abortion. In Germany there are many cases of poisoning by lucifer matches among pregnant women; and it is now admitted that in most cases the object is to produce abortion, not to commit suicide. It is quite true that phosphorus may produce abortion; but it is a poison primarily, not an abortifacient.

When the court asks an opinion as to the abortive power of a drug, it is not needful to establish its specific action on the uterus or its certainty as an abortifacient; it is sufficient to show its special liability to set up constitutional disturbances which are apt to terminate in abortion. If such a drug is given to a pregnant woman, but in too small a dose to cause abortion, or if it fails because of the peculiar strength and resisting power of the woman, the charge still holds. But if a manifestly inert or unsuitable drug is employed, the charge would not hold, though there might be a point of law as to the intention.

If abortion actually occurs, and a certain drug is known to have been taken previous to the abortion, was the abortion caused by the drug? In order to answer this question, it must be determined whether the symptoms were such as would have been caused by the drug, or whether they might have been referable to other or natural causes; whether also sufficient time elapsed between the taking of the drug and the abortion to establish a relation of cause and effect. As already remarked, these abortives act by producing severe constitutional disturbance, as the result of which abortion occurs; it is obvious, therefore, that it would be wrong to attribute abortion in any given case to the action of such a drug, unless there had been severe constitutional disturbance before the abortion took place. Most abortives are gastro-intestinal irritants, or narcotics; we would, therefore, expect to find vomiting or narcosis occurring shortly after the administration of the drug, followed by more and more marked symptoms of poisoning as time goes on; finally abortion occurs when the symptoms of poisoning are at their acme. It is important in such cases to save the vomited matters, if possible, for subsequent chemical and microscopical examination. Sometimes valuable information may be obtained from the chemical examination of the fœtal blood and tissues.

Dr. Ely Van de Warker[1] read an important paper before the New York Medico-Legal Society on the criminal use of proprietary or advertised nostrums. This paper deals with an important phase of criminal abortion, and will repay careful perusal. He states that these fœticidal preparations are dispensed in the form of pills or fluids. The oils of savin, tansy, and rue are the most active liquids. The main ingredients in the pills are aloes, hellebore, powdered savin, ergot, iron, and solid extracts of tansy and rue. These proprietary medicines generally have no directly poisonous action, but their effects on the health are very bad. A criminal use implies such persistence that functional derangement is sure to follow. The writer experimented upon himself with eleven varieties of these nostrums and details the symptoms which were produced, pointing out those which would lead one to suspect that an irritant preparation was being taken for criminal purposes. He draws attention also to an ingenious and indirect method of accomplishing the desired result. An inert pill is supplied, but among the printed instructions is the direction to drink tansy tea night and morning. This is a dangerous direction, and the intention is evident.

II. General Measures which do not excite suspicion, and are usually hard to detect and prove.

The object may be accomplished *directly* by exciting the uterus to contract, or *indirectly* by partially loosening the ovum from its attachments and injuring the membranes.

Whatever produces great or sudden congestion of the pelvic viscera or hemorrhage between the uterus and membranes is apt to cause abortion. From ancient times such measures have been in common use among the peasantry, and have been employed by women secretly or with the aid of accomplices. The following may be enumerated: Violent exercise, carrying or lifting heavy weights, long walks, running up and down stairs, jumping from a height, riding on horseback, driving over rough roads, general or local bloodletting, sinapisms to the thighs and abdomen, snuff-taking to provoke sneezing, tight lacing, leeching the perineum, vulva or inner surface of the thighs, alternate hot and cold baths, violence applied to the abdomen in the form of kicks, blows, kneading, compression with bands or ropes, beating with fists or sticks, and even standing, kneeling, or walking upon it.[1]

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[1] "Medico-Legal Papers," 2d series, New York, 1882, p. 77.

But such measures, violent though they be, do not always succeed in producing abortion. Brillaud-Lanjardière[2] relates the case of a peasant who took a pregnant woman on horseback, started off at full gallop and threw her violently to the ground; this was repeated twice, yet the woman did not abort. Hofmann tells of a peasant girl who let a heavy barn-door fall upon her abdomen without causing abortion. Another peasant, after trying various internal remedies without avail, struck his mistress on the abdomen with the flat of a sword; she fainted, but went on to full term. Hofmann mentions a case where a man, after failing with other means, sought to accomplish his purpose by frequent and forcible coitus, which he not only practised himself three or four times daily, but brought a friend who performed a similar service for him. Systematic massage of the uterus through the abdominal walls is less violent and more likely to produce the desired result; the painless contractions of the uterus are intensified thereby till true labor pains set in, and the fœtus is expelled. When abortion does result from the use of such measures, signs of external violence may be found which may throw light upon the case; but generally it will be difficult or impossible to establish a clear connection between the violence and the abortion, and determine whether the violence was accidental or criminal.

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[1] Blood-letting or leeching is supposed to act by suddenly decreasing the mass of the blood and so interfering with the placental circulation and nourishment of the child. It seldom succeeds. Moreceau reports two cases where abortion did not occur, although one woman was bled forty-eight times and the other ninety times during the course of her pregnancy. Yet the proof of recent or excessive bleeding or leeching without good cause would be highly suggestive of criminal intent. *Cf.* Gallard, "De l'Avortement," p. 23.

[2] Brillaud-Lanjardière: "De l'Avortement Provoqué," Paris, 1862.

III. Local measures, in the form of direct interference with the ovum, uterus, or parturient canal.

Irritating applications are sometimes made to the vulva or vagina; pastes or tampons saturated with irritating balsams or juices have been introduced into the vagina[1] or applied to the os uteri; hot vaginal douches are in common use. The os and cervix uteri have been dilated with tents and pledgets of various kinds or instrumental dilators. Fluids have been injected into the uterine cavity, for the purpose of separating the membranes from the uterine wall;[2] and sharp-pointed instruments have been passed into the uterus to rupture the membranes or peel them from their attachments. Sharpened twigs, roots, branches, and sticks, pieces of wire, hair-pins, knitting or crochet needles, wooden skewers, quills, toothpicks, umbrella ribs, pieces of whalebone, uterine probes and sounds, scissors, etc., have been used for this purpose. In Constantinople the women use the ribs of dried tobacco-leaves. Women often attempt to pass such instruments into the uterus themselves, and occasionally succeed, but are very apt to injure themselves seriously. When the membranes are ruptured and the liquor amnii flows away, abortion generally follows sooner or later. It is not so much the passing of an instrument into the uterus and the interruption of gestation which endanger the woman's life, as it is the hurry, inexperience, and ignorance of the operator or the filthiness of his hands or instruments. In competent hands and with a proper technique, the most serious operations may be undertaken upon the pregnant as well as upon the non-pregnant uterus, with comparatively little risk to the patient. The induction of abortion is not a serious operation and need not entail any special risks to the patient. But there is a great difference in the ease with which abortion is induced in different women, and in the time which is required with the same measures.[3] It is unsafe, therefore, to apply general rules to specific cases.

After the liquor amnii has drained away, abortion may occur in twenty-four hours, or perhaps not for days or even weeks. In Casper-Liman, a case is reported where a three-months fœtus did not come away till seven weeks after the repeated introduction of a sound into the uterus. Nothing definite can be said as to the time which massage of the uterus or violence to the abdomen may require to produce abortion. If massage sets up strong uterine action, abortion will soon follow; but if violence destroys the life of the fœtus without arousing uterine contractions, days or weeks may elapse before the fœtus is expelled. The degree of maceration of the fœtus may be some guide in estimating the time which has elapsed between the death of the fœtus and its expulsion.

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[1] Garlic, pepper, and arsenic have been so applied.—Vierteljährl. Bericht f. ger. Med., xxv., 110; also N. F., i., 321.

[2] Maschka's "Gutachten," ii., 324.

[3] For a discussion of the time required to produce abortion by the methods generally in use, see Maschka's "Handb. der gerichtl. Med.," ii., 272–278. For a description of the methods see Hirst's "Amer. Syst. of Obstet.," ii., 203–208.

The question has often been raised whether a woman is able to pass a sound or other instrument into her uterus so as to rupture the membranes and provoke labor. It is quite possible for this to be done, if the woman has been taught how; but it is always difficult and apt to be dangerous. In a woman who has borne children the uterus is generally lower down and the os nearer the vulva, than in a primipara; the os is more patent from the fissures or tears of a previous labor, it is more easily found and an instrument passed into the cavity of the uterus. It would be difficult, if not impossible, for a woman to pass a sound into her uterus if the os is high up and small, or in the virgin state.

It must not be forgotten that lacerations and wounds of the genitals may occur from indirect violence in an accidental manner. Ostermayer[1] recently reported an instructive case of laceration of the vagina without any criminal interference or operation or sexual violence. A woman, æt. 40, single, but had previously borne a child, was employed in a paper-mill. She fell down-stairs while carrying a heavy bundle of paper in her arms. She dropped her bundle and in falling struck her abdomen against the corner of a step. She immediately felt intense pain in the hypogastrium and then became insensible. In half an hour she revived, and, finding herself at the foot of the stairs, got up and went home. She then noticed blood coming from the vulva, which she took to be menstrual. Four days afterward she returned to her work at the mill. Three weeks after the accident she went to a hospital, where it was discovered that she had an oblique rent in the posterior vaginal fornix, two inches in length, looking like a clean incised wound with edges incurved toward the left. It was closed with catgut sutures and soon got well. Ostermayer attributes the wound to the sudden and forcible pressure of the abdominal and pelvic organs upon the vagina, when the abdomen struck the step. He quotes Henry's case where the bladder and anterior vaginal walls were lacerated when a woman was thrown violently out of a cart, striking her abdomen against the cart. Accidental lacerations of the vagina during sexual intercourse are common enough; sometimes they may be very extensive and may cause dangerous or even fatal hemorrhage. The diagnosis should present no difficulty.

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[1] Centralblatt f. Gyn., No. 31, 1892, p. 614.

Besides the damage which is liable to be done to the uterus and vagina by the use of a sharp-pointed instrument, the presenting part of the child is apt to be injured. It is well, therefore, to examine the fœtus (presenting part) for abrasions, punctures, or wounds. Tardieu found a punctured wound in the large fontanelle in one of his cases.

It is possible for a fœtus to be seriously mutilated or even cut up into pieces while still *in utero*. Dr. Wherry reports a remarkable case of this kind where an instrument was passed up into the uterus for the purpose of inducing abortion. Two days afterward the trunk and extremities of a three-months fœtus came away, followed in an hour or so by the head. There was no decomposition; the skin was rosy and firm. After a sharp attack of peritonitis the girl finally recovered. The conviction was secured on the medical evidence solely, the girl's own testimony being ruled out.[1]

If abortion from natural causes takes place during the first two or three months of pregnancy, the ovum usually comes away entire, if the membranes are healthy, unless they have been broken by the examining finger or an instrument. It is, therefore, of importance to determine in any case of suspected criminal abortion whether the membranes were ruptured or not. Gallard[2] insists that rupture during the first three months is highly significant of induced abortion.[1] After that period the membranes generally rupture, and the embryo comes away first, followed some time afterward by the placenta and membranes. No definite rule can be laid down which will be applicable to all cases, for very much depends upon the toughness of the membranes, the strength of the attachment to the uterus, the force of the uterine contractions, and the amount of resistance offered by the cervix.[2]

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[1] Brit. Med. Journal, June 4th, 1881, p. 880.

[2] Gallard: "De l'Avortement," p. 114; also, *cf.* Annales de Gyn., Août, 1875, p. 95.

Electricity has long been known to be capable of exciting uterine action. The faradic current was proposed by Herder (1803), and successfully employed by Hörninger (1844), and Jacoby. The galvanic current was adopted by Schrieber (1844). The use of electricity for the artificial induction of abortion in suitable cases never became general in the medical profession, and was entirely dropped for a time, but recently attention has again been directed to it. The mild faradic current is safer. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, while the positive pole is placed over the sacrum or lumbar vertebræ. Rosenstirn[3] reports a case where an electrical bath was given and abortion followed next day. Although electricity is not used very much by the profession to induce abortion, there can be little doubt that it is very frequently employed for criminal purposes, especially in the United States.

Hypnotism.[4]—It has been suggested that a woman might be hypnotized and made to destroy her child through suggestion. It is true that pregnant women are hypnotizable, but the clearest proof would be required before such a plea would be admitted as a valid defence. Moreover, it would only shift the responsibility from the mother to the person who suggested the destruction of the child. Auvard says that the forensic value of hypnotism is very slight.

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[1] Dr. De Beauvais presented to the Medico-Legal Society of Paris drawings of 300 abortive ova which Dr. Saint-Ange had collected since 1832. He concludes that the ovum is expelled entire in the majority of cases—Gallard, p. 115.

[2] Gallard's opinion is not to be relied upon in all cases; it is quite possible for healthy membranes to rupture while the ovum is being forced by a powerful uterus through a rigid and resisting cervix. Besides it is possible for the ovum to be injured after it comes away.

[3] Virchow's Jahresb., 1881, ii., 562.

[4] For full discussion of this subject, see Gilles de la Tourrette: "l'Hyponotisme au Point de Vue Médico-Légal," Paris, 1887.

SEQUELÆ OF ABORTIONS.

After it has been proved that a criminal abortion has taken place, and that certain drugs or manipulations were employed for that purpose, the medical expert may yet be called upon to say whether the woman's health was injured by those measures, whether her life was endangered thereby, and, if death took place, whether the abortion was directly or indirectly the cause.

Subsequent ill-effects may be due either to the abortion itself, or to the means employed to produce it. The most important after-consequences of the abortion itself are hemorrhage, sepsis, and subinvolution with its attendant troubles.

Hemorrhage is usually severe, far more so in some cases than in others. It is due to the rupture of vascular connections which have been established between the uterus and ovum for the growth and development of the embryo. As soon as the uterus can empty itself and close the mouths of the bleeding vessels by firm contraction, hemorrhage ceases. It is evident, therefore, that the degree and persistence of the hemorrhage will depend upon the speed and thoroughness with which the ovum can be expelled. The hemorrhage will be comparatively small if the ovum is completely extruded within a few hours; it is apt to be abundant or alarming if days elapse, or if all or part of the placenta and membranes remain behind. The circumstances of each case, the strength of the patient, the period of pregnancy, and the amount of blood lost must be taken into account in giving an opinion.

Sepsis.—The views usually set forth in works on medical jurisprudence are not in accord with the teachings of modern surgery. While the occurrence of septicæmia after an abortion may excite suspicions as to the use of instruments or criminal interference of some kind, it affords no reliable evidence one way or the other. The induction of abortion is not more likely to produce septicæmia than any other operation of equal gravity. Artificial abortion performed with strict antiseptic precautions, and with the same care and attention to details as is usual in other surgical work, should be a comparatively harmless operation for the mother.

Sepsis is caused by pus-producing micro-organisms introduced from without, not by causes existent in the woman or inherent in the operation. Septicæmia undoubtedly occurs more frequently in criminal than in natural abortion or abortion artificially induced by the obstetric surgeon;[1] but the reason is that the ignorance, unskilfulness, or carelessness of the operator, the unsanitary condition of the surroundings, or the uncleanliness of the patient or her attendants, favors the entrance of pyogenic germs. Natural abortion in a dirty patient with dirty surroundings would be far more apt to end in septicæmia than an artificial abortion with considerable violence and loss of blood, if strict antiseptic precautions had been observed. The teachings of modern antiseptic surgery should be borne in mind when estimating the after-consequences of criminal abortion.[2]

Subinvolution, with its attendant flexions, versions, displacements, menorrhagia, leucorrhœa, etc., is very apt to follow abortion. Much depends upon the thoroughness with which the uterus was emptied, the length of time the patient remained in bed, and abstained from active work or exercise, the amount of blood lost, and the nourishment and care she had afterward. In criminal abortion, secrecy is the great object; the patient is therefore more likely to get out of bed too soon and resume her ordinary employment, and less likely to get the rest, care, and nourishment necessary for a good recovery.

Ill effects from abortive measures are proportionately common. As already shown, most abortifacient drugs are irritant poisons and produce abortion by exciting grave constitutional disturbance. If given in large doses the symptoms are acute, if in smaller doses continued for a longer time, they are subacute or less marked. If the woman aborts and recovers, the convalescence is protracted and subacute, or chronic gastro-intestinal symptoms are apt to continue for a long time. Hemorrhoids, general debility, nervous prostration, irritability of the bladder, indigestion, vomiting, diarrhœa, constipation, symptoms of pelvic congestion, and menstrual disturbance may be mentioned as common after-effects of abortive drugs.

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[1] Sepsis is highly suspicious but not conclusive of interference. It has been estimated that a fatal result occurs in 79 per cent of cases of criminal abortion. Out of 96 cases of criminal abortion, 76 ended fatally, while of 26 cases of abortion carefully induced with antiseptic precautions, none died.

[2] It might become a question in cases of malpraxis whether proper care had been taken to provide against the risks of infection. Was the technique aseptic? Did the operator act according to the principles of modern antiseptic surgery? If not, would he not be open to a charge of criminal carelessness or negligence? In such a case it would be necessary to exclude other causes of death, and other means of conveying infection.

When vaginal douches have been used or fluid has been injected between the membranes and the uterine wall, there may be peritonitis or metritis, usually septic in origin; or sudden death from the entrance of air or fluid into the uterine sinuses, or acute peritonitis from the passage of air or fluid along the Fallopian tubes into the abdominal cavity. When instruments have been introduced by ignorant or unskilled persons to rupture the membranes and bring on labor, traumatisms are almost certain to exist. These are usually confined to the vulva, vagina, cervix, and lower part of the uterus; but where much force has been used they may be found even in the fundus. The size and appearance of the traumatism will depend upon the kind of instrument used, and the amount of force or roughness. Small sharp-pointed bodies like sounds, knitting-needles, etc., produce punctured wounds which may be hard to detect and may be easily overlooked. If the woman is alive, they may have closed completely before the examination is made, the appearances differing in no respect from those of natural abortion. When scissors or large rough instruments have been used, or where much violence has been done, the traumatisms will be correspondingly greater and more easily recognized. They will have the appearances of cuts or tears with more or less bruising. The fœtus may or may not be injured, even if the uterine wounds extend as high as the fundus. Hofmann relates a case where the posterior bladder wall was perforated. Dr. Jackson reports the wounding of the internal iliac artery by an instrument used to bring on abortion. Maschka[1] reports five cases of fatal perforation of the uterus during an attempt to rupture the membranes. The history in all was much the same; they visited or were visited by a midwife, some instrument was passed into the uterus, then came hemorrhage, pain, vomiting, fainting, and abortion, followed by symptoms of acute septic peritonitis, and death in from two to five days. Post-mortem examination showed abundant purulent fluid in the abdomen, evidences of general and recent metritis and peritonitis, and a large flabby uterus with a wound somewhere in its walls (some-

[1] Vierteljahrsschrift f. ger. Med., xli., 270; xlii., 32.

times perforating, sometimes not), with irregular necrosed edges.

Sometimes the most frightful injuries are produced. A strong young woman, æt. 20, in the fourth month of pregnancy, had labor induced by a physician by means of a hard gum elastic catheter. Either the force used in introducing it or the uterine contractions caused the catheter to perforate the fundus and make its way up under the liver. During his frantic efforts to remove the placenta, he scraped through the cervical wall and removed portions of it for placental tissue. He then introduced an ovum forceps through the cervical wound, and dragged down a loop of intestine, mistaking it for the cord, and tore away a portion of the bowel.[1] In another case, a woman, æt. 28, IIpara, in her fourth month, was seized with severe pains while washing windows. The next night the fœtus came away, and the midwife removed the so-called afterbirth by pulling upon the cord. The post-mortem showed that the uterus had been partially inverted, probably by the traction on the cord, and that while trying to separate the placenta she had gouged out and removed the whole of the fundus.

The expert must not only determine the site, extent, and probable origin of the traumatisms, but must trace the septic or inflammatory processes to them, excluding other causes.

A case was tried in Paris in the spring of 1881, which attracted considerable attention at the time from the social standing of the accused, who was a retired army surgeon, nearly seventy years old, and Commander of the Legion of Honor. His victim was a girl of eighteen. Peritonitis set in shortly after the operation had been performed, and the girl was removed to a hospital, where she died. Professor Brouardel found lesions about the genital organs which indicated criminal interference; but in addition there was a cyst in the liver sufficient to cause death. The accused was acquitted because Professor Brouardel could not tell positively whether death was caused by the cyst in the liver or peritonitis following the operation for abortion. Moreover he suggested that possibly the cyst in the liver may have been produced by the criminal violence.[2]

Where traumatisms are found, the important question to determine is whether they occurred spontaneously or were produced artificially.[1] Perforating wounds of the uterus do not occur spontaneously; penetrating rupture of the uterus is very rare, generally occurring at or near full term, the uterine walls being weakened near the point of rupture by disease, cicatrices, or fibromata. Healthy uterine tissue does not tear spontaneously; and unhealthy conditions can be made out by careful microscopic examination of the tissue near the site of the tear. Is it thin or cicatrized, is a fibroid situated near by, or was the placenta attached thereabouts? The size, shape, and appearance should be noted. In the first six months, spontaneous rupture is still rarer, although it has occurred in the fourth, third, or even second month.[2] Rupture of the uterus may occur in the early months in the rudimentary horn of a double uterus.[3] Ruptures of the uterus apart from labor have been doubted, yet Hildebrandt has published one case.[4] Piltz[5] describes a rare case of spontaneous rupture of the fundus during labor. A rare case of spontaneous rupture of the uterus in the cicatrix of a previous rupture was reported recently with a diagram in the *Archiv für Gynäkologie.*[6] Remarkable cases

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[1] Amer. Journ. of Obstet., July, 1892, p. 69.

[2] Brit. Med. Journal, Oct. 30th, 1880, p. 722; Feb. 19th, 1881, p. 285.

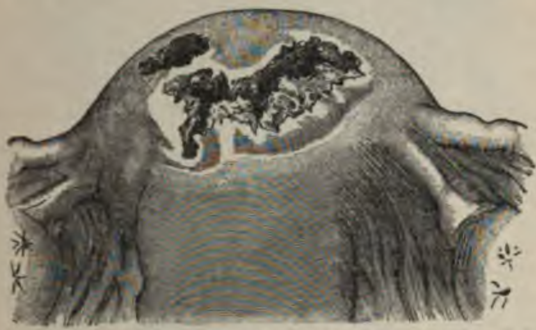

FIG. 23.—Multiple Perforation of the Fundus Uteri with Septic Softening of the Edges Causing Subsequent Enlargement of the Original Wounds. The woman was in the the fifth month of pregnancy and passed a goosequill into her uterus to induce abortion (Hofmann).

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[1] *Cf.* monograph by Dr. Marsais: "Des Blessures de la Matrice dans les Manœuvres Criminelles Abortives," Lyon, 1890. He has collected 68 cases, and enters fully into the ways by which a spontaneous perforation may be distinguished from an artificial wound.

[2] Monatsch. f. Geburts., xii., 408.

[3] Maschka, in Prag. Med. Wochenschr., 1882, No. 49.

[4] Virchow's Jahrsb., 1872, p. 669.

[5] Deutsch. med. Zeitung, 1889, p. 1221.

[6] Archiv f. Gyn., xliv., Heft 3, p. 396.

of recovery after rupture of the uterus have been recorded. A very extraordinary one was published by Rose[1] in the *Chicago Medical Journal and Examiner*, in which rupture of the uterus took place in four successive pregnancies (1869, 1872, 1874, 1876), in the same woman with a normal convalescence in all.

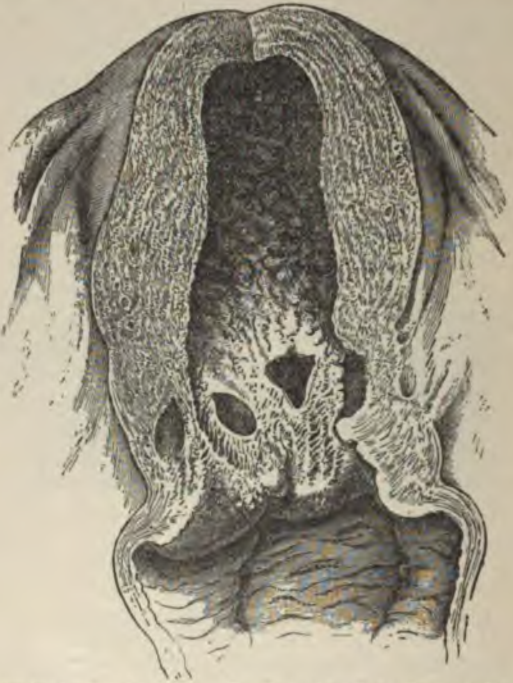

FIG. 24.—Abortion in the Third Month. Death in ten days from peritonitis. Wounds about the os internum, with loss of substance (Hofmann).

When determining the kind of instrument used in making a certain wound, it should be remembered that a slight wound or puncture may be greatly enlarged by uterine contraction or subsequent necrosis. Spencer Wells[2] states that during an ovariotomy, he accidentally punctured the pregnant uterus. The small wound suddenly enlarged into a great tear during and as the result of uterine contraction. Inflammation and necrosis may also extend the size or alter the shape of a wound.[1] When the wounds occur in the cervix, it may be claimed that they were the natural result of labor and not caused by violence. A careful study of the symptoms as well as an examination of the parts will usually give sufficient data upon which to base an opinion. Hofmann describes two cases illustrating the appearances in a fatal case of perforation of the cervix (Figs. 23 and 24).

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[1] Centralblatt f. Gyn., i., p. 316.

[2] Med. Times and Gazette, Sept. 30th, 1865.

Rupture of the uterus may also occur from forcible injections of fluids into its cavity.[2] The site of the rupture is important to consider in diagnosing spontaneous from traumatic rupture.[3] Spontaneous ruptures are usually in the cervix or lower uterine segment, are transverse or oblique, rarely longitudinal, have the appearance of a tear, and are usually accompanied by copious hemorrhage, sometimes proving rapidly fatal. Artificial ruptures may be anywhere, and are usually multiple, sometimes involving the intestine, bladder, rectum, or vagina, are generally longitudinal, there is necrosis or suppuration only in the vicinity of the wound, the mucous membrane being healthy elsewhere.[4] Other accidents may occur during the introduction of instruments into the uterus for the induction of abortion. Death may occur from shock.

Vibert[5] reports an interesting case in which shock occurred at the moment a rubber canula was introduced into the cervix, and the woman died in five minutes. The abortionist (a woman) was expert and experienced, having done over one hundred abortions in a year. Her method was to introduce a canula into the cervix and distend the lower uterine segment with injections of water. (Case No. 6.)

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[1] Winter presented such a case to the Berlin Gyn. Soc. on Nov. 12th, 1886, and Richardière mentions another (Virchow's Jahrsb., 1888, i., 516). *Cf.* also Hofmann, pp. 257-260.

[2] Coutagne: "Des Ruptures Utérines pendant la Grossesse, et de leurs Rapports avec l'Avortement criminel," Paris, 1882.

[3] It may be impossible to determine from the post-mortem examination whether a rupture of the uterus was spontaneous or caused by violence or manipulation. The violent nature can be affirmed only if the rupture is situated above the contraction-ring, and in cases where there has obviously been instrumental perforation of uterus or vagina. In crossbirths, if the rupture can be made out to have been on the side where the breech lay, it was probably due to violence. Hemorrhage is the cause of death after rupture of the uterus, only when immediate. If death occurs after twelve to twenty hours, it was probably due to sepsis before symptoms of peritonitis had time to develop.

[4] Compare Lacassagne: "Des Ruptures de la Matrice consécutives à des Manœuvres abortives," Paris, 1889, pp. 5-12.

[5] Société de Médicine légale—Bulletin Méd., 1890, p. 639.

Tetanus has occurred after criminal abortion; Sattler[1] reports the case of a healthy woman, æt. 30, IIIpara, in her second month, who developed tetanic symptoms on the second day after the passage of an instrument for the induction of abortion, and died on the fourteenth day. There was a small perforating wound of the posterior vaginal wall (Fig. 25).

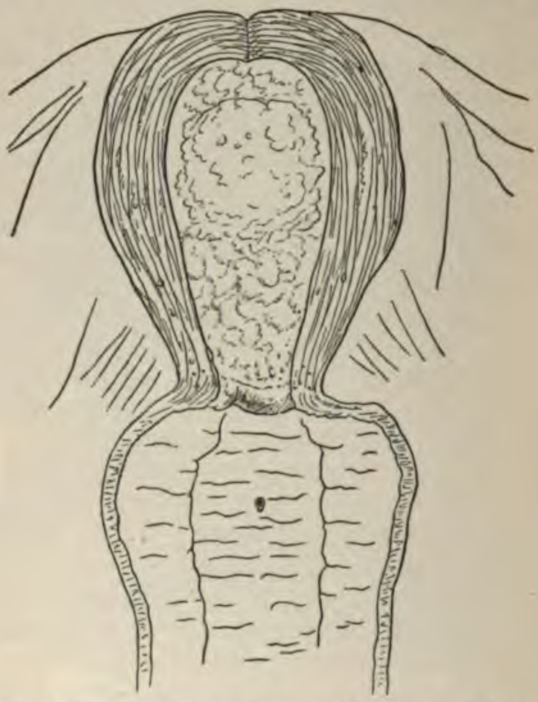

FIG. 25.—Perforating Wound in Posterior Vaginal Wall with Loss of Substance. The wound was oval, 3 mm. long, and 2 mm. broad, with discolored edges. The patient died of tetanus on the seventh day (Sattler).

While the uterus sometimes resents interference, it occasionally withstands much handling without being provoked to expel its contents. Fritsch[2] passed a sound on the 20th October for the purpose of inducing abortion. Considerable pain was felt when the point of the sound entered the os. A laminaria tent was then passed into the cervix and the vagina tamponed. When the tampon and tent were removed, there was hemorrhage, and it was supposed that the ovum had come away. The patient not being satisfied that the uterus had been emptied, Fritsch passed a sound into the uterine cavity fourteen days afterward, and moved it about in every direction; considerable blood came away, yet pregnancy continued. On the 14th January following, a bougie was introduced into the uterus and left there, and abortion finally resulted. Oldham[1] records a case where it was sought to induce abortion in the third month on account of vaginal contraction. A sound was passed into the uterine cavity without further result than a white discharge, and slight pain in the abdomen. After twenty-six days, the membranes were ruptured and abortion took place in seven days.

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[1] Sattler: Inaugural-Dissertation: "Ein Fall von Tetanus nach kriminellem Abortus," Tübingen, 1890.

[2] Centralblatt f. Gynäkologie, iv., p. 197.

THE DUTIES OF MEDICAL EXPERTS IN CASES OF CRIMINAL ABORTION.

I. EXAMINATION OF THE WOMAN.

During Life.—The value of medical evidence depends upon the time which has elapsed between the abortion and the examination. The sooner an examination is made, the more likelihood will there be of obtaining positive evidence; the longer it is deferred, the greater likelihood will there be of fallacy and negative results. Much depends upon the period of gestation; the earlier it is, the less marked will be the signs diagnostic of abortion. Each case, therefore, must be decided upon its own merits, as no general rule can be laid down applicable to all. In some cases, abortion cannot be affirmed positively after twenty-four hours; in others it may be demonstrable after several weeks. When bits of placental tissue or fœtal membranes are found adhering to the uterine walls days or weeks after the expulsion of the embryo, the proof of abortion is positive; but a diagnosis based upon the examination of the woman before the formation of the placenta is very uncertain and liable to many fallacies. The phenomena of profuse menstruation, subinvolution after a previous abortion or confinement, enlargement and congestion of the uterus from fibroids, polypi, and other causes, may lead to error. Before declaring positively for abortion, the medical expert must exclude these and all other pathological conditions which might produce similar appearances. There need be no very great difficulty in doing this; a careful bimanual examination, the thorough exploration of the pelvic cavity and its contents (under ether if need be) should seldom leave much room for doubt. Method and thoroughness in the examination are essential for the formation of a trustworthy and positive opinion.

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[1] Lond. Med. Gazette, 1894.

It would greatly facilitate the ends of justice if the courts would take expert advice and draw up a series of rules for the preparation of medical evidence and the making of post-mortem examinations in medico-legal cases. The general practitioner unaccustomed to medico-legal work is very apt to overlook matters of vital importance from the legal point of view; indeed a case often hinges upon slight circumstances which at the time of examination may have seemed unimportant. If a complete examination is not made at once, it may be too late afterward; every hour impairs, every day destroys significant evidence, which no amount of care, skill, or experience can subsequently restore or replace. It will, therefore, be readily understood that only a relative value can be placed upon the evidence obtained from the examination of the living woman.

The signs of abortion are usually stated to be general relaxation of the genital tract, patulousness of the os and cervix, with or without fissures, erosions, or tears, the presence of lochia, varying in color and character according to stage, from the reddish discharge of the first few days to the greenish, whitish, or yellowish discharges of later periods. The enlargement of the breasts with their characteristic color-changes, and the presence of colostrum, are valuable points. Traumatisms of the vulva, vagina, and cervix can only be made out satisfactorily by inspection, in a good light, with the aid of speculum and retractors. The size of the uterus is determined by bimanual examination. The constitutional symptoms will depend upon the period of pregnancy, the amount of violence, the expertness of the operator, and the use or neglect of antiseptic precautions. There may be no rise of temperature or pulse and no constitutional disturbance. The importance attached by older writers to the temperature, pulse, dryness of skin, sunken eyes, haggard countenance, etc., must be largely discounted nowadays when expertness in gynæcological operations is greater and more general, when the technique is improved, and obstetricians are accustomed to practise the rules of antiseptic surgery. The expert should not confine his attention to the breasts and genitals, but should also examine the body for marks of violence.

After Death.—If decomposition is not too far advanced, the examination post-mortem should be easier and give more definite results than one made during life. The whole pelvic viscera and genital tract should be carefully inspected, great care being taken to avoid jagged cutting when examining the uterus and vagina. The organs should be laid open with clean-cut incisions, lest post-mortem wounds be mistaken for or confounded with traumatisms connected with the abortion. These latter are usually in the form of punctures or lacerations, irregular in contour, accompanied by loss of substance, and generally multiple. If the woman has lived for some time, there will be efforts at repair, cicatrization, more or less complete granulation, and the presence of blood, lymph, or pus about the wounds. Spontaneous or natural wounds or tears are recognized chiefly by their site, extent, and appearance. Care should be taken to look for evidence of irritant poisoning by abortifacient drugs—the stomach, intestines, kidneys, bladder, and urine should be minutely examined. Are the viscera in a state of general anæmia from sudden and profound loss of blood? If the woman died during a menstrual period, it should be borne in mind that the uterus and pelvic viscera will probably be found in a state of congestion.

II. The Examination of the Ovum, Fœtus, Clots, etc.

If a fœtus has been expelled, the examination should determine its probable age, maturity, and viability, whether it was born alive, the cause of death, the presence of wounds or injuries, and whether these were inflicted during life. If any portion of the fœtal membranes are discovered (amnion, chorion, placenta) the proof will be positive; but a microscopic examination is necessary to remove all doubt. While the presence of fœtal structures absolutely proves abortion, their absence does not prove its non-occurrence. A careful inspection should be made of blood-clots, stains upon the bedding or clothing, and a microscopic examination made if necessary.

III. THE EXAMINATION OF DRUGS, OR INSTRUMENTS SUPPOSED TO HAVE BEEN USED TO PRODUCE THE CRIMINAL ABORTION.

Instruments should be examined carefully for stains of blood, hairs, and fragments of maternal or fœtal tissues. It is also important to compare them with any wounds which may exist on the body. With regard to drugs it is important to determine not only what they are but also how active they are. Liman[1] records a case where a decoction of savin had been taken as an abortifacient; the residue was sent to him for examination. He found it dried up and odorless when rubbed; he testified that the sample submitted to him was inert as an abortive, having lost its active principle entirely. Liman[2] reports another case where a physician was accused of having prescribed an abortifacient mixture for a widow. The questions submitted to the medical expert were, whether the mixture if taken as prescribed was such as would produce abortion, and whether by the use of it the patient's health was seriously endangered. The prescription was a strong infusion of senna and savin with saffron syrup and cream of tartar. After taking this mixture for three days the woman aborted. The prominent symptoms were profuse diarrhœa, sharp cutting abdominal pains, weakness in the thighs, and inability to work for several days. These were all attributed to the senna, which was given in large enough doses to cause severe intestinal irritation and sympathetically excite the uterus to contraction. The other ingredients were considered as inoperative in the case, and the opinion was given that the mixture as prescribed was likely to cause abortion and seriously injure the patient's health.

Tidy gives the following table, which may be useful for reference as suggesting the line of inquiry to be adopted in cases of suspected criminal abortion:

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[1] Casper-Liman, i., 241. Many popular abortifacient drugs owe their power to an ethereal oil which soon evaporates, leaving the residue inert. Decoctions made from dried herbs are often inert on this account.

[2] *Ibid.*, i., 261.

I. *Examination of the mother, if living.*

(1) Temperature.
(2) As to the woman's predisposition to abort, and the period at which abortion has commonly occurred.
(3) General state of health. (Note existence of leucorrhœa, excessive menstruation, syphilis, asthma, malignant disease, uterine diseases, etc.)
(4) Whether the woman be well- or ill-formed. (Note pelvic malformations, effects of tight lacing, etc.)
(5) Whether or not there be signs of recent delivery or of the expulsion of uterine contents.
(6) Whether any cause can be assigned to account for the abortion (*e.g.*, violent coughing, blood-letting, straining at stool, violent exercise, undue excitement, septic poisoning, violence, administration of medicines, etc.).
(7) All injuries of the genital organs. (Consider whether the injuries might be self-inflicted.)

II. *Examination of the body of the mother, if dead.*

Note
  (*a*) The necessity for care not to mistake the effects of menstruation for those produced by abortion.
  (*b*) To avoid injuring the parts by the knife or otherwise during the autopsy.
  (*c*) To consider the possibility of injuries being self-inflicted.
(1) Note the existence of any marks of violence on the abdomen or other parts.
(2) The condition of the genital organs, noting all inflammations, rents, tears, perforations, etc. (if the uterus be injured, if should be preserved).

Note also
  (*a*) The condition of the passage (relaxed or otherwise).
  (*b*) The condition of the os uteri (virginal, or gaping, etc.).

- (*c*) Vaginal secretions, and if present, their character.
- (*d*) The general appearance of the breasts, presence of milk, etc.

(3) Whether there be any signs of irritant poisoning in the stomach, or inflammation of the bladder, kidneys, rectum, etc. (The contents of the stomach to be preserved if necessary.)

(4) Whether the viscera generally indicate loss of blood during life.

III. *Examination of the product of conception.*

(1) Nature of the supposed product of conception.

(2) Consider whether there is evidence of a diseased condition of the membranes or placenta, *e.g.*, structural degeneration.

(3) If a fœtus be found, determine (*a*) whether it was born alive; (*b*) its probable age; and (*c*) the cause of its death.

(4) Determine whether, if there be wounds or other injuries, they were inflicted during life or after death.

IV. *Examination of all drugs, instruments, etc.*

If the woman is living and can be kept under observation for a short time, the progressive involution of the uterus and disappearance of the signs found during pregnancy will enable a positive diagnosis to be made. As involution proceeds the uterus should become smaller, the discharges less copious and bloody, the breasts more flaccid and free from milk, the dark pigment streak down the linea alba should fade, so should the dark color from the areola. No pathological condition at all resembles the process of involution.

In examining clots and other matters which may have passed from the genitals of the accused, it is always of prime importance to examine carefully for any signs of a product of conception. It is well to float all suspected matters in water, when the ovum or any portions of the chorionic villi which may be present will float free and can generally be recognized without difficulty. If any small fragments of tissue are found in the water which look suspicious or doubtful, a small portion should be clipped off with scissors and examined microscopically on a glass slide in either water or glycerin; if it is chorionic tissue, there will be easily seen under a low power the characteristic chorionic villi with club-shaped ends containing a vascular loop covered with flattened epithelium (see Figs. 26, 27, 28, 29). If these are not found, or if the villi happen to be imbedded in uter-

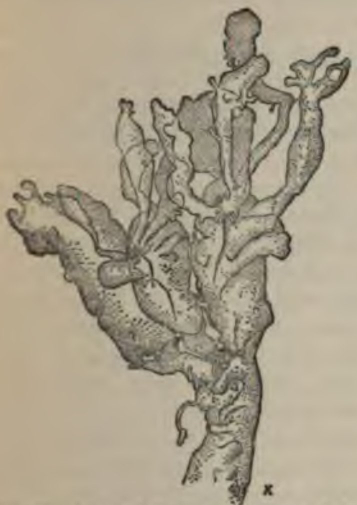

FIG. 26.—Isolated Terminal Branch of a Villus from the Chorion of an Embryo of

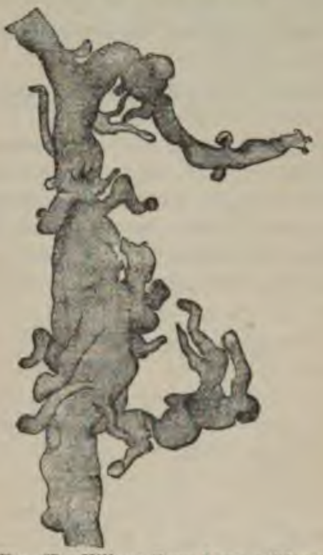

FIG. 27.—Villous Stem from a Placenta of the Fifth Month. × 9 diams.

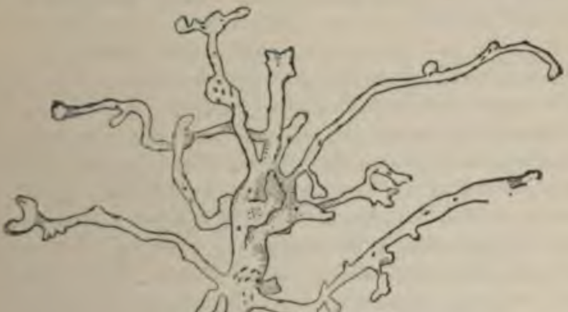

FIG. 28.—Terminal Villi of a Placenta at Full Term. The little spots represent the proliferation islands of the covering epithelium.

ine decidual tissue (as in the case of fragments removed from the internal surface of the uterus by curetting), it is better to imbed the portion to be examined in paraffin or celloidin, then cut sections and stain them and examine under the microscope.

ILLUSTRATIVE CASES—ABORTION.

1. *Fatal Case of Criminal Abortion—Conviction of the Abortionist. Trans. Massachusetts Med. Leg. Soc., i., p. 79. Boston,* 1888 (Gleason).—A woman in the sixth month of pregnancy and in perfect health went upstairs with Dr. Gilson carrying a basin of warm water; in twenty-five to thirty minutes he came down hurriedly for brandy; when the servants went up with him they found the woman lying on the floor dead. A tub containing a small quantity of bloody water was near by. One of the servants had lent the doctor a common rubber syringe which was found concealed in a bureau close to the bed, *still wet.* A strange nozzle was attached to this syringe, which fitted to a female catheter which dropped from the person of Dr. Gilson when he was committed for trial. The strange nozzle was not on the syringe when lent to the doctor and did not belong to it. A bottle of tincture of aloes and myrrh was found in the room, and a small quantity of cotton-root extract in the kitchen. The servants testified that the doctor had visited the deceased and that she had taken both the cotton-root and tincture. The post-mortem showed that force from without had dissected up the membranes and edge of the placenta. Water or any similar fluid forcibly infected into the uterus would produce similar appearances. There was no evidence of disease or any other cause of death than uterine interference. There had been very little blood lost, and death was due either to shock, embolism, or the entrance of air into the uterine veins. The syringe was leaky, and air no doubt entered the uterus along with the fluid.

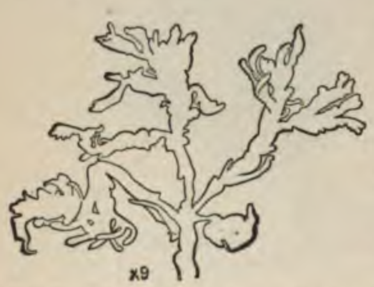

FIG. 29.—Aborting Villus from a Chorion of the Second Month.

2. *Fatal Case of Criminal Abortion—Septicæmia (unpublished)* (Cameron).—A multipara, æt. 42, had been under the care of a noted abortionist for gastro-enteritis. She had several large hemorrhages from the genitals, and had been vomiting for several days. When she came under observation she was delirious, deeply jaundiced, with a subnormal temperature and rapid thready pulse. An offensive discharge was coming from the vulva. She was douched out, and the

uterus thoroughly curetted, removing a quantity of decidua and some placental tissue. She died of septicæmia five days after having come under observation.

Post-Mortem.—The parotid glands on both sides were swollen, the neighboring tissues being œdematous. There were numerous points throughout the gland tissue from which a small quantity of thick curdy pus could be squeezed. The cervical glands were also slightly swollen. The mammary signs of pregnancy were present and there was milk in the breasts containing colostrum corpuscles. There was broncho-pneumonia of the right lung with embolism of the right pulmonary artery. In the abdomen there were signs of commencing general peritonitis. The uterus was enlarged; the placenta had been attached low down on the left side, and reached to one-quarter of an inch from the internal os. Just within the external os were two depressed furrows with considerable loss of substance, one on the right, the other on the left side of the canal. They were evidently of traumatic origin and recently made. Edges undermined, deeper above than below, no signs of granulation or cicatrization. Tubes normal. No traumatisms in vagina. The opinion was given that death was due to septicæmia following an abortion probably induced by the introduction of uterine sound or other such instrument. There was no evidence of gastro-enteritis, for which the accused claimed that he was treating her.

3. *Case of Criminal Abortion—Retention of a Piece of Gum-Elastic Bougie for More than Eleven Months. Brit Med. Journ., June*, 1894, *p.* 1,187 (Sykes-Ward).—The patient consulted Dr. Sykes-Ward about a sinus situated over the sacrum which had been discharging for over six months. There was a purulent discharge from the vagina and on examination a foreign body was felt partly in the vagina and partly in the uterus. The vaginal portion was bent round and rested on the posterior wall. It was removed with considerable difficulty and proved to be a piece of gum-elastic bougie five and one-half inches long. There was no evidence of perimetric inflammation or implication of neighboring viscera. The patient admitted that the bougie had been introduced by a woman who is now undergoing penal servitude for procuring abortion in another case. The bougie was inserted on November 3d, 1893; she miscarried two days later, and suffered from pain in the back and purulent discharge from the vagina up to April, 1893, when the sinus began to discharge. She recovered completely in a fortnight after the removal of the bougie. It must have been so tightly wedged in the uterine tissue that it did not come away when the abortion took place.

4. *Case of Criminal Abortion by Means of Tartar Emetic. "Avortement Criminel démontré au bout de plusieurs Mois par le Diagnostic retrospectif de la Grossesse," Lyon*, 1887 (Fochier and Coutagne).—Caroline B., pregnant about four months, was taken by

her lover to an abortionist. On three days consecutively a powder of antim. tart. (probably ten centigrammes each) was administered, followed by violent and repeated vomiting without colic or diarrhœa. An infusion of powdered red madder, which is used commonly by the lower classes in Lyons as an abortifacient, was administered several times. Once a concentrated infusion of absinthe was given, followed in three days by abortion. The only efficient one of these remedies was the tartar emetic, whose action was due to the mechanical effect of severe vomiting. It was suspected that these potions were supplemented by some direct interference with the uterus. This case is well worthy careful study from the thorough and efficient way in which the medical investigation was carried out.

5. *Fatal Case of Phosphorus-Poisoning and Abortion. Vierteljahrssch. f. ger. Med.*, 1893, *vi.*, *p.* 280 (Seydel).—On November 2d, 1892, a woman well advanced in pregnancy was brought to the Königsburg lying-in hospital, with skin and conjunctiva markedly icteroid, gums and buccal mucous membrane covered with numerous punctiform blood-spots and saliva mixed with blood. She was tender on pressure in various parts of the body—urine dark-red and containing blood and bile-pigment. The following morning, on attempting to get out of bed to urinate, she fell unconscious on the floor. Hemorrhagic patches the size of the palm appeared on left thigh and right knee as result of the fall. A similar patch appeared on upper left eyelid. In the afternoon of the same day, two dead twins were spontaneously delivered. There was moderately severe hemorrhage, and after the separation of the second placenta the patient died, retaining consciousness to the very last. Subsequent investigation showed that she had soaked probably one hundred matches in water and drunk the fluid on the evening of the 28th October. The first symptoms were observed on the following morning, severe vomiting, complete loss of appetite, so that thenceforth she only took water. Nevertheless she tried to do her work on the 30th and 31st, and went to her mother's house in the same village on the evening of the 31st. The clinical signs of phosphorus-poisoning, great prostration and muscular weakness, a small frequent pulse and weak heart-beat, were present and necessitated lying in bed till the time of her death. The vomiting was not very excessive or frequent. On post-mortem examination the liver was found very fatty, the cells of the acini generally being filled with fat-drops. The kidneys also showed advanced fatty degeneration of the epithelium of the uriniferous tubules, while the glomeruli were but little affected and showed no signs of necrosis. Fatty changes not much advanced in the heart-muscle. The twins were about the twenty-fifth to twenty-seventh week. Macroscopically there were no special changes in the organs except bleeding on the cranial bones and in the brain, and extravasations of blood in the serous cavities. Microscopic examina-

tion showed no special change in heart and kidneys, but in the liver there was scarcely a cell without large fat-drops. Compare Miura's experiments upon animals (Virchow's *Archiv*, xcvi.)

6. *Fatal Case of Criminal Abortion by Vaginal Injections. Annales d'Hygiène Publique, Jan.*, 1893, *p.* 71. The celebrated Thomas case (Vibert).—In Paris the woman Thomas throve for several years as an abortionist and gained wide reputation for her ability and success. Her method was to pass a canula into the cervix or high up into the vagina, and inject water or some infusion. She did not use a speculum nor did she guide the canula with the other hand, but carried it directly to the top of the vagina with one hand, adjusted it in a minute or two, and then gave the injection. The whole operation including the injection did not last on the average more than five minutes, and was painless according to the testimony of her patients. Although there was no local pain, yet there was sometimes immediately set up a state of general malaise together with symptoms indicative of profound disturbances of the nervous system. At last a fatal case occurred, and investigation exposed the extent and method of her operations. A healthy, vigorous, well-formed young woman, about four and a half months pregnant, applied to Thomas for an abortion. In the presence of another woman, a canula was passed with one hand into the vagina without the aid of a speculum. The accused was preparing to inject water through the canula when the patient complained of great malaise, slipped down on the floor, lost consciousness, groaned several times without being able to speak, and died in a few minutes. Death can be explained only by reflex action by inhibition of the nervous system provoked by excitation of the cervix. No doubt this is rare, but Vibert subsequently hunted up seventy-two women who had been operated on by the accused, and examined them carefully; of the number, six others during the injection or immediately after were seized with faintness, dizziness, vomiting, etc., which generally lasted some hours and then disappeared without leaving any trace. Those reflex symptoms came more rapidly in some cases than in others. In the fatal case, they came the moment the canula was introduced, in others during the injection of the fluid, and in others not till some minutes afterward. More than nine-tenths of the patients had no such symptoms. The quantity of liquid seemed to make no difference, nor the number of times the injection was repeated. In the fatal case there had been great haste, excitement, and heat after a hearty meal: the condition of digestion no doubt played an important part. In more than half of the cases, flow of blood began within twenty-four hours, most frequently in six to eight hours. In five cases it began in one hour. Sometimes it did not begin for ten to fifteen days or even upward of a month. Cramps and pain in the back soon followed the flow of blood. Only four or five were ill or feverish enough to be forced to

stay in bed for a few days—but about one-fourth of the women were found to be suffering from metritis with well-marked objective signs. With regard to the number of injections required to bring on abortion, Vibert found one woman who was injected twenty times in the same pregnancy, another eleven times, one eight times, one five times, five four times, three three times, twenty-one two times, and forty-three once.

7. *Abortion by means of a Seton-Needle Introduced into the Uterus. Archiv. Gén. de Méd., Paris*, 1823, iii., 80–83 (Crouzit).—A young woman had been bled several times and freely to produce abortion, but without effect. A seton-needle six inches long was then passed into the uterus so far that it could not be withdrawn. The operator assured the patient it would come away with the fœtus. It did not do so, however. After suffering severe septic symptoms pain was felt in the inguinal region about the thirty-fifth day: a painful swelling formed, and finally on the seventy-ninth day the needle was discharged from the groin.

8. *Fatal Case of Abortion Following the Introduction of a Piece of Wood into the Uterus. Méd. Lég.*, 1829, *p.* 329 (Smith).—A woman about six months pregnant applied to a midwife for an abortion. A sharpened piece of wood was pushed up into the uterine cavity. A living child was eventually born, but the mother died soon after. At the post-mortem a number of tears and perforations were found in the uterus, about which gangrenous inflammation had been set up.

9. *Fatal Case of Abortion—Perforation of the Uterus. Archives d'Anthrop. Crim. et des Sciences Pénales*, 1889 (Lacassagne).—A woman, æt. 40, died at Lyons on April 9th, 1889, under suspicious circumstances. The body was exhumed and examined on April 27th. The liver, spleen, and kidneys were much decomposed, the uterus comparatively fresh. In the middle of the fundus uteri was an opening with tolerably regular borders, 34 mm. long, corresponding to the transverse diameter of the uterus, and 11 mm. broad, terminating at the right in a notch. The anterior part of the uterus was red and blackish in certain parts. The left ovary and broad ligament were large and infiltrated with blood. A corpus luteum in left ovary. On cutting into the uterus, it was found to be enlarged like a pregnant uterus, but there was no sign of ovum or fœtus. Three little tumors were found on the mucous membrane, one the size of a cherry-stone, which contained blood. About the perforation, the edges were ragged and the uterine parietes were eroded in a cone-shaped manner, the base corresponding to the mucous membrane. The product of conception was not found in the abdominal cavity. The opinion was given that the woman had been about two and one-half months pregnant; that an abortion had been produced by the introduction of some instrument, that the fundus had been perforated thereby, and that death had occurred on the fifth day from metro-peritonitis. Spontaneous rupture of the uterus could be absolutely excluded.

INFANTICIDE.

GENERAL CONSIDERATIONS.

INFANTICIDE means the murder of a new-born child. It is not a specific crime under the English law, but comes under the same rules as other forms of murder. In order that a charge of infanticide may hold, the child must be new-born, must be alive when criminal violence is used, and must die from the effects thereof. It matters not whether the child lives for minutes, hours, or days; infanticide holds if its life is destroyed after its birth. To substantiate such a charge, the law requires satisfactory proof that the child lived after complete birth, and that its death was due to criminal violence. The fact of live-birth must be clearly proved by the prosecution, otherwise the law assumes the child to have been dead-born and the charge of infanticide will not hold. In other words, the law assumes all children to have been born dead, unless it can be proved that they were born alive; the onus of proof rests on the prosecution. Furthermore, it is not enough to prove that the child was alive when violence was used, and that death ensued therefrom; it must be clearly established that the fatal violence was inflicted *after* birth. It is evident, therefore, that in cases of infanticide much depends upon the medical evidence. The medical expert is generally the most important witness, and a great deal is expected of him, far more sometimes than he is able to perform. In giving evidence, he should confine himself strictly to the medical aspects of the case, laying before the court a full and clear statement of the appearances he has observed, and the conclusions fairly deducible therefrom. The legal bearings and the interpretation of the facts are entirely out of his province and should therefore be avoided. He is not trying the case, nor is he responsible for the conviction and punishment or acquittal of the accused; these are the duties of judge and jury with which he has nothing to do, and with which he should not interfere. Legal enactments vary in different countries, and at different times in the same country; the same law is sometimes interpreted differently by different judges. The legal point of view may vary considerably;[1] the scientific point of view with which the medical man has chiefly to do, is subject to less variation. His duty is to enlighten the court as to the medical facts of the case, and his testimony forms but one link in the chain of evidence. It is, therefore, safer and wiser for him to confine himself to his own province. In cases of infanticide the medical witness is called upon to assist in solving the four following questions:

1. Was the child born alive?
2. If so, how long did it live after birth?
3. Was death due to natural causes or to violence?
4. Was the violence accidental or criminal?

I. WAS THE CHILD BORN ALIVE?

The question of live-birth is a very important one, both from its criminal and civil bearings. In *criminal* courts charges of concealment of birth or infanticide, in *civil* courts questions of inheritance, tenancy by curtesy, the disposition of property, etc., may depend upon whether a child was born alive or dead. Here at once confusion is apt to arise from differences in the medical and legal definitions of live-birth. The law must lay down arbitrary lines for its own guidance with which the medical witness must not interfere. From his point of view life begins with conception and continues until terminated naturally or by violence. Birth is merely the expulsion of the child from its mother's body, and from the scientific standpoint has no necessary connection with the life or death of the child. If for the sake of convenience, or as the reflex of opinion, usage, or custom, the law declares that a child must be completely extruded from its mother's body before its destruction can be called murder, or that it must have breathed and cried, or that it must have had an existence independent of its mother, the question of live-birth from the scientific standpoint is not affected thereby. These are mere arbitrary conditions which may vary in the penal codes of different countries, or may be modified or altered from time to time. The law must have broad principles of action to enable it to grade and classify crimes and apportion fitting punishment. With such matters the medical witness has nothing whatever to do. He will save himself annoyance and further the ends of justice if he confines himself to the scientific aspects of the case, laying the medical facts before the court and leaving it to interpret the law and use his evidence in whatever way it deems proper. If the law of the land as interpreted by the courts requires as proof of live-birth that the child has cried, moved, or breathed after being completely extruded from its mother's body, it is obviously useless and needless for the medical witness to contend that in his opinion the child lived after its birth because he observed something else which the law does not recognize as a proof of live-birth. It is quite sufficient for him to state what he did observe and the conclusions he has drawn therefrom leaving the court to use his evidence along with all the other evidence elicited in the case in coming to a conclusion. Controversies respecting what should constitute proof of live-birth are right and proper in medical societies and journals, but quite out of order in a court of law. The medical witness is not in court to impeach the law or prove that its findings are wrong. Attention to this matter would greatly simplify medical evidence in cases of infanticide and prevent much unnecessary friction.

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[1] The Austrian statutes distinguish between legitimacy and illegitimacy in estimating guilt. A woman who destroys a legitimate child is considered more guilty than one who destroys an illegitimate one.

Although the English law does not define live-birth, yet the decisions and rulings of the courts are fairly clear. In the eye of the law, a child has been born alive, if there has been "the manifestation of some certain sign or signs of life after it is completely born." No particular sign of life is required, nor even evidence of independent life; two conditions only are essential: (1) Complete extrusion of the child from its mother's body, and (2) some certain sign of life. All the judges agree that the child must be completely delivered, before it can be considered as legally born. From the scientific standpoint it does seem absurd to hold that a child is not born because one foot remains in the vagina, although the rest of its body has been lying for some time in the bed and it has been breathing or crying. Yet such is the law, and if the child is murdered before the foot is completely extruded from the maternal passages, the charge of infanticide will not hold. It is always hard for a medical witness to swear positively that the child was completely born before it was assaulted, unless he was present himself, and miscarriage of justice has repeatedly occurred from inability to establish complete birth in the legal sense. The date of birth is the moment of complete delivery. Tidy mentions a case where the head was born one minute before midnight on December 31st, 1799, but the body was not completely born till one minute after midnight; that child's birthday was January 1st, 1800. In cases of twins or triplets, the eldest is the one which is first completely born, although previously another may have been partially born.[1]

According to English law the second essential condition of live-birth is the existence of some certain sign of life—the pulsation of the cord, the beating of the child's heart (either seen, heard or felt), motions of the limbs, twitchings of the muscles, wrinkling of the brows, puckering of the face, opening of the eyes, have all been considered proofs of live-birth, although respiration did not take place. In a case which came under my own observation the breech presented and the labor was tedious and difficult. Immediately after birth the fœtal heart-beat could not be made out by auscultation, the cord had ceased to pulsate, there was no attempt at respiration, and the only sign of life was that the child opened its eyes a couple of times. It was not resuscitated, but was held to have been born alive. A moment of life after birth gives the same rights as hours or days.

When a woman is accused of infanticide, she should be examined, if possible, to determine whether she has been recently delivered. The medical witness should remember that such an examination cannot be made without her consent. He may lay himself open to an action for assault if he forces an examination against her will. A woman who is accused of murder cannot justly be forced to furnish evidence for her own conviction. Neither coroner, magistrate, nor police can give a physician the legal right to examine a woman against her will, no matter whether she is eventually proved to be innocent or guilty; she must give her free consent to make the examination legal. The coroner can give an order for the examination of a dead body, but not a living woman. (See EXAMINATION OF THE LIVING, Vol. II., pp. 251–259.)

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[1] In twin cases, midwives and nurses sometimes tie a string or ribbon around an arm or foot which has come down first into the vagina, to determine which child is the elder. This practice is not in accordance with the law, and may do serious injustice if inheritance depends upon primogeniture.

The evidence obtainable to substantiate the presence or absence of live-birth may be conveniently considered in two classifications:

I. Evidence of life or death obtainable immediately after birth.

II. Evidence of life or death obtainable from a post-mortem examination.

I. EVIDENCE OBTAINABLE IMMEDIATELY AFTER BIRTH.

If any sign of life was noted the proof is positive; but the fact that no such sign was noted is no proof that life did not exist. Mere heat of body is not a sign of life, because the child when born has at least the same temperature as its mother's body. Cadaveric rigidity is not a sign that live-birth took place.

Fœtal Heart-Beat and Pulsation of Cord.—If the fœtal heart can be seen, felt, or heard beating, or if the cord is still pulsating, the child is alive. As long as circulation goes on, it is possible to establish respiration; but when the heart ceases to beat life ceases. The heart-beat is therefore the ultimate test of life. But its apparent absence is not a proof of death, for it may be beating so feebly that it cannot be heard or felt.

The feebler and more immature the child, the longer may its heart keep on beating feebly, provided respiration is not established. Bouchut records a case where the heart-beats were audible for twenty-three hours after birth, although there was no sign of respiration during that time.

The length of time that apparently dead-born children may survive is sometimes remarkable. Cases are recorded where they have been buried and afterward dug up and resuscitated.

Champneys[1] mentions a case reported by Dr. Roper where a child was dissected the day after still-birth and the heart was found beating. Another child born at five and one-half months was thought to be dead and left on the floor for eleven hours on a cold night; in the morning it was found to be alive.[1] Two illegitimate children were buried and resuscitated after several hours. Another was buried for five hours, restored to life, and lived for three days (Bohn). Another was for eight hours buried in a field, 25 cm. below the surface of the ground; it was disinterred and lived four days (Bardinet). Maschka reports a case where a child apparently dead-born was coffined after attempts to resuscitate it had failed; twenty-three hours after birth the heart-beat was audible with the stethoscope, though all efforts to revive it failed. Such cases show how careful the attendant should be in pronouncing upon the death of new-born infants.

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[1] Champneys: "Experimental Researches in Artificial Respiration in Still-born Children," 1887, p. 134.

Muscular Movements.—Slight movements of the limbs, twitchings of the eyelids, wrinkling of the brows, puckering of the face, sucking movements of the mouth, especially if the finger is put beween the lips or on the tongue, opening of the eyes, or any independent muscular movement on the part of the child occurring after complete delivery, must be accepted as proof of life. But the evidence of unskilled observers should be received with caution, as they are apt to be deceived.

Crying is a positive proof of life but not necessarily of live-birth, for the child may cry before being completely born. In delicate, feeble, or immature children crying may be absent, or so feeble as to be heard only by those close at hand; in the confusion, bustle, or excitement at the time of birth the child's cry might be easily overlooked.

It is possible for the child to cry in utero, or while passing through the vagina or vulva, and perish before being completely born. This can happen only after rupture of the membranes, and is rendered possible by air finding its way into the vagina or uterus and reaching the child's mouth and nose. Professor Holmes,[2] of McGill University, Montreal, reported a remarkable case of this kind in the *Edinburgh Medical and Surgical Journal.* (See case 32.) Similar cases have been recorded and are mentioned by Ogston,[3] Taylor, and Tidy.[4] S. Marx attempted to

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[1] Lancet, Nov. 27th, 1880, p. 852.

[2] Edin. Med. and Surg. Journal, xxxiii., 1830, p. 215. For details see report at end of this article.

[3] Ogston's "Med. Jurisp.," 1878, p. 247 *et seq.*

[4] Tidy's "Legal Medicine," Am. ed., 1884, vol. iii., pp. 156, 179, 180.

deliver in a case of contracted pelvis by introducing the hand and seizing a leg. He heard the child's muffled cry during the manœuvre; it was born asphyxiated and could not be revived. Collyer heard a child cry while traction was being made with forceps; version was at once performed, but the child was born dead. Grandin[1] heard the child cry in utero while he was performing version. The child was large and the pelvis contracted. As the foot appeared at the vulva a distinct cry was heard like that of an angry child, and was repeated whenever the foot was pulled; the head was at that time in the upper uterine segment. The crying was distinctly heard by Drs. Grandin and Sims and two nurses who were present in the room; it ceased as soon as the trunk was delivered. The child was born asphyxiated, but as there was no liquor amnii or mucus in the respiratory passages it was soon resuscitated.

On the other hand, the child may live for hours or days before it utters a cry; this is most apt to occur in premature children, and is due to debility. Ogston claims that if the lungs show signs of having fully respired, the child has in all probability cried. In order that crying may be accepted as a proof of live-birth, it must be shown to have taken place after the child was completely born.

In trials for infanticide the evidence respecting the child's cry may take several forms. Testimony may be offered that the cry was actually heard by persons who were in the room at the time, and they had ascertained that the child was or was not completely born. Or it may be proved that no cry was heard by any one who was present at the time of the birth, and that it would have been impossible for it not to have been heard if the child had cried after its birth.

Breathing.—The slightest gasp or attempt to breathe is a positive proof of life; but the child may breathe, as it may cry, any time after the rupture of the membranes, either in the uterus or in the process of birth. Breathing is consequently a sign of life but not necessarily of live-birth. On the other hand, absence of breathing does not necessarily mean absence of life. The child may breathe in utero (vagitus uterinus), if air has entered the uterine cavity and the respiratory centre in the medulla has been prematurely stimulated by the accumulation of CO_2 in the blood. This accident is most likely to happen in face presentations when the mouth lies over the os uteri, or during attempts to deliver by forceps or version. The evidence of the medical attendant would be conclusive in such cases, and the criminal destruction of the child by its mother during or after birth would be improbable or impossible. Breathing may occur while the head is passing through the vagina (vagitus vaginalis); this accident is also rare, and presupposes a small child or roomy pelvis and vagina, with access of air.

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[1] New York Journ. of Gyn. and Obst., April, 1894.

More frequent than either of these is the occurrence of breathing while the head is protruding from the vulva. In such a case there would be little or no obstruction to the entrance of air into the lungs, and the maternal passages would not compress the child's body sufficiently to prevent the action of the respiratory muscles. It would be reasonable to suppose that the child would be born alive unless it was subjected to some violence before the rest of its body was delivered.

The medical witness has no means of distinguishing between breathing which occurs when the head is protruding from the vulva, and breathing after complete delivery. Yet there is an important distinction from the legal point of view, and the whole case may turn upon the ability to make this point.

Still-Birth.—Some confusion exists respecting the meaning of this term, and it has been very generally confounded with dead-birth. A child is *dead-born*, if it is dead when completely born. It is *live-born* if there is any sign of life after it is completely born. It is *still-born* if it is *live-born* but makes no attempt to breathe and finally dies without respiration having been established. *Still-born* children are always *live-born*, and the term still-born ceases to be applicable after the first gasp for breath. It is, therefore, incorrect to designate or certify as *still-born*, those children which have breathed and lived feebly for a few minutes, hours, or days.

Maceration or putrefaction positively proves death before birth, if found present a short time after birth. No conclusion can be drawn if there has been sufficient time for putrefaction to become far advanced. When the fœtus perishes in utero, it *macerates* if it remains for some time surrounded with liquor amnii and air does not gain access to it. It *putrefies* if air reaches it, bearing the micro-organisms which cause putrefaction.

In maceration the epidermis is first affected. Numerous blebs or vesicles form between the cutis and the corium; these blebs resemble pemphigus, and contain a red serous or serosanguineous fluid. They usually begin to form about three days after the death of the fœtus. The corium is infiltrated and becomes brownish-red. The epidermis is easily detached and comes away in flakes. There is œdema, most marked over the head, hands, feet, abdomen, and sternum. The body is flaccid and usually distorted in appearance, swollen in some parts, depressed or unchanged in others. The cranial sutures are separated and the bones freely movable, the head feeling often like a loose bag of bones. The brain becomes grayish, red, and pulpy. The joints are sometimes disarticulated, and the periosteum detached from the long bones. The serous cavities fill with serosanguinolent fluid and the blood-vessels with dark grumous blood. All the viscera are infiltrated and friable, the uterus and lungs remaining longest unaffected. There is a disagreeable sweetish odor, quite different from the offensive smell of putrefaction. The longer the fœtus has remained dead in utero, the more pronounced are the signs of maceration. The microscopic appearances of the tissues are characteristic. Lempereur distinguishes three stages of maceration: (1) From the 1st to 10th day, (2) from the 10th to 40th, (3) from the 40th to 60th. Sentex describes minutely the progress of maceration from day to day.[1]

Grave mistakes have arisen from want of care in distinguishing the results of maceration from pathological changes; even dislocation of the joints and mobility of the cranial bones in a macerated fœtus have been mistaken for the effects of violence. It is also worthy of note that congenital pemphigus has been mistaken for the signs of maceration. Hofmann reports a case of this kind. If a macerated fœtus remains in the uterus or abdominal cavity a month or more, the blood more or less leaves the body through transudation or imbibition, and the fœtus has a bleached fatty appearance. But the striping of the muscle is distinguishable for a long time under the microscope and a careful examination enables the organs to be made out.

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[1] Charpentier: "Traité Pratique des Accouchements," 2d ed., pp. 1,027-1,030. Maceration changes have been studied carefully and described by Lempereur, Sentex, Ruge and Martin. The two latter call a macerated fœtus, "fœtus sanguinolentus." Ruge describes F. Sanguinolentus, *cf.* Zeitschrift f. Geb., i., 57; *cf.* also Berlin. klin. Wochensch., 1882, No. 34; M. Martin (Lyon), "Mémoires de Médecine et de Chirurgie Pratique," Paris, 1835.

Putrefaction requires air, moisture, and heat. The soft parts disintegrate and decompose, evolving the characteristic putrefactive odor, which is sometimes very offensive. Gases form in the fœtal cavities, and sometimes in the uterus, producing the condition known as physometra. The fœtal subcutaneous tissues crepitate, and the abdomen may become so distended as to interfere with delivery. As a general rule, fœtor of the liquor amnii during labor and physometra are taken as signs of death or putrefaction of the fœtus. That this is not always so, is shown by the following case reported by Leblond.[1] The patient, æt. 21, entered *la Maternité de Cochin, Paris,* under Dr. Bouilly. Being at full term, labor set in and the waters came away; when she reached hospital, the liquor amnii was fœtid and the pains ceasing. During the night she had several rigors and severe abdominal pain. In the morning the stench in the ward was horrible, and on examination a small quantity of offensive black discharge was found coming from the vulva. The head presented in the first position of the vertex. The uterus was much distended and resonant on percussion toward the fundus; the skin was hot and pulse rapid (140). Forceps were applied at once and a well-formed living child extracted; at the same time there came away from the uterus with much noise a quantity of gas and fœtid black liquid. The cord was small and greenish; the placenta was greenish on its fœtal side, but normal on the maternal aspect; the membranes were very friable. Baudelocque had a case where the child was born alive with all the signs of intra-uterine putrefaction, but the cause was attributed to a gangrenous eschar on the top of the child's head. Fœtor and physometra are not uncommon if the membranes have been ruptured a long time before the child is born, and may be due to a decomposing clot of blood. A good summary of the views of Siebold, Naegelé, Plouvier, Desormeaux, Deubel, etc., together with the report of a number of cases, may be found in Chatelain's[2] thesis on intra-uterine fœtal putrefaction.

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[1] Nouvelles Arch. d'Obstétrique et de Gynécologie, 1892, vii., p. 309.

[2] Chatelain: Thèse de Paris, 1883.

Intra-uterine putrefaction while the fœtus is still alive may be due to putrid decomposition of clots in the uterine cavity. Fœtor of the liquor amnii is generally caused by the entrance of air after early rupture of the membranes, and comes on very rapidly in some cases. The fœtor is sometimes not very pronounced, and may therefore be overlooked or attributed to other causes. It is not an uncommon condition and it would be very unsafe to affirm the intra-uterine death of a fœtus on the ground of the putridity of the liquor amnii, or the putrefactive changes in the sheath of the cord or the fœtal aspect of the placenta.

Mummification.—Drying up and shrivelling of the fœtus is rare and is of course a sign of intra-uterine death. It usually occurs when the fœtus dies at the third or fourth month, and no air enters the uterus. It must not be forgotten that a fœtus may mummify after birth instead of putrefying, if there is absence of moisture and other conditions are favorable.

Respiration.—Of all these signs the greatest stress medico-legally is laid upon the proof of *respiration*. In some countries and by some authorities proof of respiration is deemed essential in establishing the fact of live-birth. This view, however, is not accepted by the majority of medical jurists. Breathing and life are not synonymous, for a child may be alive and yet not have breathed. Life is wider and more comprehensive than breathing; a child that breathes must be alive, but one that is alive need not breathe. Before birth, the placenta is the fœtal lung. It is a composite organ, partly maternal and partly fœtal, by means of which the mother supplies the fœtus with oxygen and relieves it of CO_2. The fœtal heart pumps the fœtal blood to and from the placenta, and maintains the circulation in the fœtal body. The mother's heart keeps the placenta provided with sufficient maternal blood to supply the fœtal demand for oxygen, and relieve it of its waste matters. As long as the fœtal heart keeps beating the fœtus is alive, and the respiratory function is carried on more or less efficiently in the placenta. But during labor the uterine contractions compress the placenta, and interfere more or less with the supply of maternal blood; the crippled placenta then becomes less and less able to do its work and finally ceases to function altogether; CO_2 accumulating in the fœtal blood excites the medullary respiratory centre into activity, and the first gasp for breath denotes the transference of the respiratory function from placenta to lung. This gasp usually occurs immediately after birth; but sometimes it may be before or in the process of birth, or not till some time after.

If the lung is fully able to undertake its new functions, respiration becomes completely established and the child lives and thrives; but if it is unable to aerate the blood sufficiently for the maintenance of life, the child slowly asphyxiates; or if it cannot function at all, the heart soon ceases to beat and the child dies; or if there is some delay in starting respiration after birth from mechanical impediment or other cause, the preservation of the child's life may depend upon the rendering of suitable and timely assistance. The transference of the blood-aerating function from placenta to lung is therefore only a change in mechanism, a new phase in the advancing life of the fœtus, just as the development of the placenta was a distinct advance upon earlier nutritional arrangements.

It is evident, therefore, that respiration may be set up at any time, either before, during, or after birth, whenever CO_2 accumulates in the fœtal blood in sufficient quantity to excite the respiratory centre into activity. Any cause which interferes with the maternal or fœtal circulation, or produces local engorgement of the placenta, may produce this state of blood, and the fœtus may slowly asphyxiate or gasp for breath while still in utero or in the process of expulsion therefrom.

It occasionally happens that the placenta does not separate at once from its uterine attachments; in that event, a modified placental circulation continues after the child is born, and respiration may not be at once established. But when the cord is tied or divided, all vascular communication with the mother ceases, and the child must breathe or perish. If eventually it breathes, in what condition was it while it lay wholly delivered, with cord undivided and placental circulation still continuing? It was not breathing, but was it alive? If respiration is a necessary sign of life after birth, it was not alive; when then did it begin to live? If, however, respiration is not eventually established, and the fœtal heart grows weaker and weaker till it finally ceases to beat, was the child alive after its birth or not? It is obvious that the position of those who insist upon respiration as a necessary factor in live-birth, is untenable.

It is claimed by some authorities that by the term *life* the law means *independent* life, which may be carried on without the aid of the mother, and that respiration is essential for independent life. Granted, if the definition of independent life is in the legal sense only, made for convenience and not to be considered as scientifically accurate. But suppose a child born with fœtal heart beating; the cord is tied and cut, and for a time there is no breathing; the heart still beats feebly, Sylvester's method is practised, respiration is finally established, and the child's life is saved—in what condition was that child before it drew its first breath? It was completely born, separated from its mother, not dead, but yet not legally alive if respiration is to be considered an essential condition of legal life. Again, if violence is employed while the child is in that state, and respiration does not take place at all, is the crime *fœticide* or *infanticide?* These are questions of law, with which the medical witness has nothing to do, and with which, if he is wise, he will refrain from meddling. For the physician, life begins with conception and ends with the last heart-beat; circulation may exist for a short time without respiration, but respiration cannot exist without circulation. The medical witness should state plainly the appearances he has observed, leaving the legal applications and deductions to the court.

VIABILITY.

The viability of a child, that is, its ability to keep on living after its birth and to attain maturity, sometimes comes up in this connection. The more immature the child, the greater the chance of its being born dead or of its dying from natural causes. Different codes assign different periods for viability. In France the earliest period when a viable child may be born is set at 180 days (six calendar months). In Scotland it is 168 days (six lunar months). That does not imply that a child is as likely to live at 168 days in Scotland as at 180 days in France. It simply means that for convenience of administration the laws of these countries set an arbitrary time-limit for viability which happens to be different. As a matter of fact, viability in any given case depends not so much upon the actual age of the fœtus as upon the development and power of its organs and their fitness to perform their functions. It is quite possible therefore for a certain nine-months child to be less capable of living and reaching maturity than another of eight months which is stronger and possessed of a better all-round development.

II. EVIDENCE OBTAINABLE FROM A POST-MORTEM EXAMINATION.

Marks of violence, such as abrasions, burns, cuts, bruises, etc., should be carefully noted. It should be ascertained whether they occur only on one side of the body or not, also whether they might have been produced by the mother trying to deliver herself. If there are any marks about the neck, could they have been produced by a cord or ligature of any kind applied with sufficient force to impede or prevent respiration?

Changes in the Shape of the Chest and Position of the Diaphragm.—The thorax is flat before respiration is established, arched or rounded after. It has therefore been proposed by Daniel to measure the chest in order to determine live-birth; no reliance can be placed upon such measurements as a test. The diaphragm is arched and rises high up in the thorax before respiration, but becomes flattened and depressed after. This is altogether a question of degree. The change is well marked if respiration has been complete and long continued, but slight if respiration has been imperfect or of short continuance. Diaphragmatic changes therefore are useless as a test of live-birth, though they may sometimes have a certain corroborative value.

Changes in the Lungs.—The lungs undergo important changes as the result of respiration. During intra-uterine life they have no function and receive only sufficient blood for their proper growth and development. The aeration of the fœtal blood takes place in the placenta, and the full pulmonary circulation is not established. The main current of venous blood is switched off from the lungs by the ductus arteriosus and carried from the pulmonary artery directly into the aorta, whence it passes through the umbilical arteries to the placenta. In the fœtus, the lungs lie in the back part of the chest, and are small, dense, non-crepitating, and of liver-like consistence. (Fig. 1, Pl. IV.) When respiration begins, the collapsed air-cells distend

EXPLANATION OF PLATE IV.

FIGURE 1.—Uninflated lung of infant which died immediately after birth. Subpleural ecchymoses and sanguineous infiltration of some interlobular septa.

FIGURE 2.—Lung of new-born infant, for the most part filled with air, to a less extent unexpanded; with interstitial emphysema, produced during life.

FIGURE 3.—Unaerated lung of a dead-born infant, with post-mortem discoloration and subpleural and interstitial emphysema due to putrefaction.

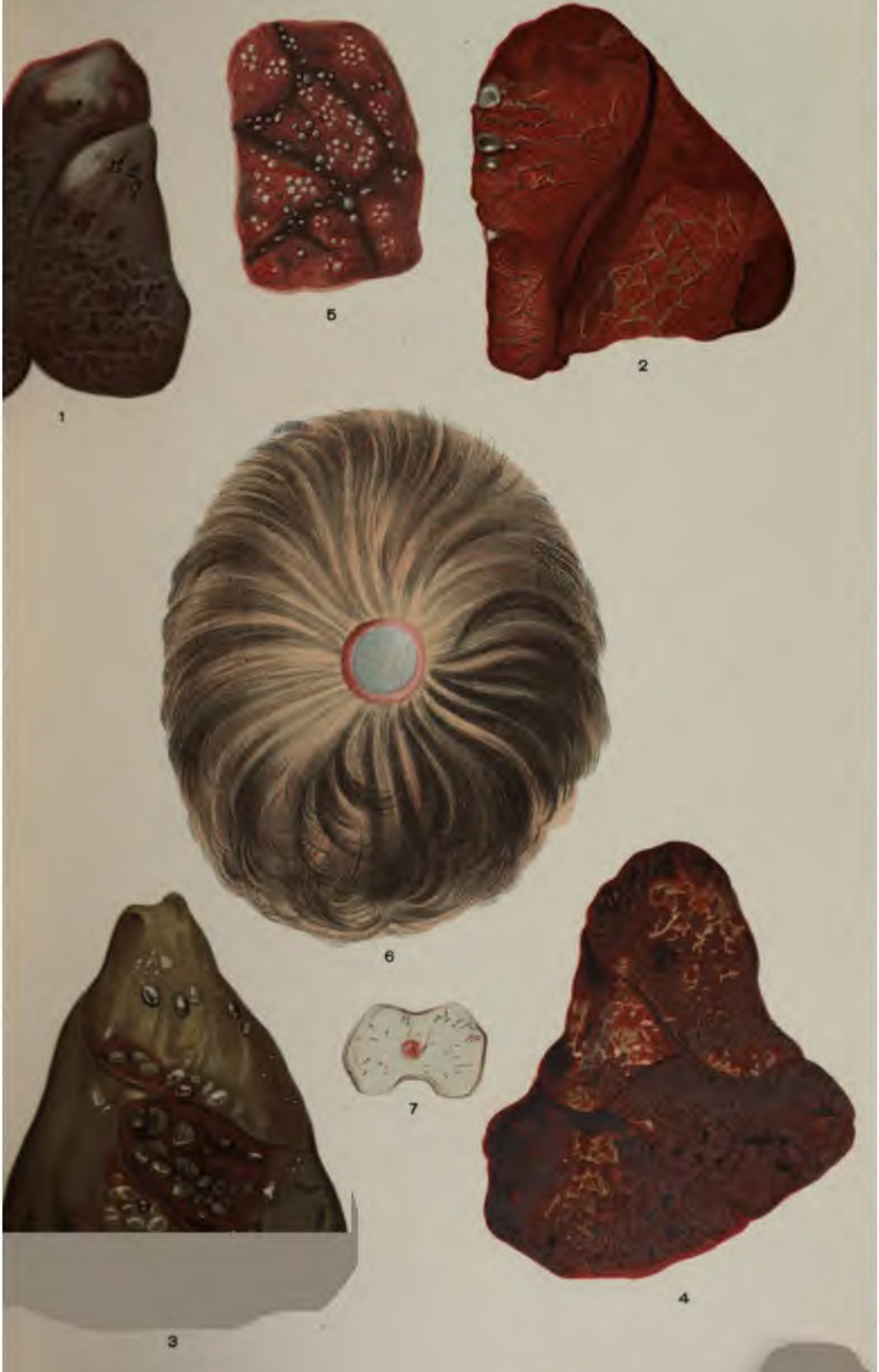
FIGURE 4.—Unaerated lung of a dead-born infant; with many alveoli filled with inspired liquor amnii. Subpleural ecchymoses.

FIGURE 5.—Piece of a partially aerated lung, with subpleural emphysema due to putrefaction. Magnified six times.

FIGURE 6.—Curious intra-uterine injury on the head of a new-born child—commencing cicatrization.

FIGURE 7.—Centre of ossification of the lower epiphysis of the femur of a dead-born infant at term.

MEDICAL JURISPRUDENCE—PLATE IV.



INFANTILE LUNGS, Etc.

with air, the pulmonary circulation commences, and the lungs alter in volume, consistence, color, weight, and specific gravity. When the child gives its first gasp, air passes down the bronchi, distending some of the air-cells and expanding portions of the lungs, rendering them paler in color (Fig. 2, Pl. IV.) crepitating, and more bulky. The deeper the respirations and the longer they continue, the more air-cells become distended and the greater the changes in the lungs. The passage from the fœtal state to that of fully developed function is a gradual process, extending sometimes over hours, days, or weeks, the rapidity depending largely upon the strength of the child and the presence of conditions favorable to respiration.

It is obvious, therefore, that the length of time a child has breathed can give only an approximate idea of the completeness of respiration and the lung changes which might be expected to be present. The first air-cells to distend are usually on the edges and concave surface of right upper lobe, and it is there that we look for the first signs of respiration. When distended with air, these cells are polygonal or angular in outline, arranged symmetrically in groups of four, though less frequently they may be irregularly scattered; they are easily distinguishable by the naked eye,[1] and vary in tint from bright vermilion to light rose-red according to the amount of blood contained in the lung. They are slightly raised above the surface and are not obliterated or displaced when the finger is rubbed over them. These appearances distinguish them from putrefactive patches and melanotic spots, but not from air-cells distended by insufflation or artificial respiration. The mottled or marbled appearance presented by groups of rose-colored spots on the dark liver-like background of fœtal lung is considered highly characteristic of natural respiration. Putrefactive patches are generally larger, and the gases can be displaced by pressure of the finger and made to move about in different directions by pressure. (Fig. 3, Pl. IV.) Tardieu's method is to prick each air-bubble; if they are putrefactive the air can be all pressed out without difficulty.

The color changes are directly proportionate to the extent of expansion and the amount of aeration, not to the length of time respiration has been going on. A few full, deep breaths may change the color more than hours of feeble superficial breathing. More or less rose-color may be developed by exposing the lungs to air after death, but dilatation of the air-cells can only be effected by the entrance of air through the bronchi; no amount of post-mortem exposure will distend the air-cells. As a rule the anterior portions of the lungs show the color changes better than the posterior portions, which are apt to contain more blood from hypostasis. For the same reason anæmic lungs are lighter colored than congested ones.

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[1] A lens of low power is sometimes of great assistance in doubtful cases.

Sometimes the lungs of children suffocated shortly after birth can scarcely be distinguished from those in which suffocation took place before birth; yet on close examination a small quantity of air may generally be discovered symmetrically distributed through the air-cells, although the color may be practically the same.

It follows therefore that dark-colored lungs are not always airless, neither do light-colored lungs always contain air. Fœtal lungs cut like liver and frothless blood exudes; lungs which have breathed crepitate on section and frothy blood exudes.

Static Test.—ABSOLUTE WEIGHT OF THE LUNGS (FODERÉ'S OR SCHMIDT'S TEST).—When respiration begins the blood is diverted from the placenta and directed along the pulmonary arteries to the lungs, which fill with blood and become heavier. It has been suggested that evidence of live-birth might be obtained by comparing the weight of the lungs in any given case with the standard weight of lungs which have not breathed. In order to do this, ligatures are placed about the pulmonary vessels to prevent the escape of blood, the lungs are then carefully separated from the heart and thymus gland, removed along with the trachea and bronchi, and weighed.

The average weight before respiration is variously estimated at 430 to 649 grains. The weight of lungs which have breathed depends upon the extent and long continuance of respiration, the completeness with which the pulmonary circulation has been established, and the amount of blood drawn into the lungs. In feeble, premature children or those which have breathed imperfectly, less blood enters the lungs than in strong, full-term children or those which have breathed freely and for some time.

New-born children vary in weight ordinarily from three to twelve pounds; the weight of the lungs may be expected to vary in proportion to the weight and development of the child. It is quite possible therefore for the lungs of a large child which has not breathed to weigh more than those of a small child which has breathed.

So many sources of error have to be guarded against that this test cannot be relied upon as a test of live-birth, and can be assigned only a relative value.

Relative Weight of the Lungs to the Weight of the Body (PLOUCQUET'S TEST).—It was claimed by Ploucquet and his followers that the relative weight of lungs to body is 1:70 before respiration, and 1:35 after respiration. No value is now attached to this test, as it is admitted that no constant relation exists between the lung-weight and body-weight of children, either before or after respiration.

Specific Gravity (HYDROSTATIC TEST).—The specific gravity of the lungs before respiration is variously estimated at 1040 to 1056; after respiration it is 940, the reduction being due to the presence of air. Lungs in the fœtal condition sink in water, those containing sufficient air float.

The method of applying the test is as follows: After securing the larger vessels,[1] remove the heart and lungs entire, place them in a vessel of water at a temperature of about 60° F. (15° C.), and note whether they sink or float. If they sink, note whether they do so partially or completely, slowly or rapidly; if they float, whether they do so high above the level of the water, on the level, or slightly below the level. If both sink, separate them and try them one at a time, because the right lung may float while the left one sinks, or the right may sink more slowly and to less depth than the left. If both sink separately, cut each into twelve to twenty pieces, and test each of these in the same manner. If any pieces float, squeeze them separately between thumb and finger under water and note whether any little bubbles of air are given off, and whether the pieces still float. Béclard exerts pressure in a different way. He wraps the pieces which float in a cloth, places them on the floor, covers them with a board and puts a heavy weight on the board, or stands upon it, thus applying a uniform, even pressure to all the pieces; he then puts them once more into water and notes whether they still float. Vibert directs the pieces of lung to be squeezed as forcibly as possible between thumb and finger under water; he lays great stress upon the fine bubbles which rise, not larger than pinheads, in a sort of fine foam. He says a positive opinion can hardly be given, if putrefaction is well advanced.

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[1] German medical jurists ligature the trachea; the French do not consider it necessary to do so.

If the lungs sink separately and in pieces, there is no evidence that respiration has taken place. If some pieces float, the child has probably breathed imperfectly; if the lungs float separately or *en masse*, respiration has been pretty thoroughly established. Sinking denotes absence of air; floating denotes presence of air and is usually presumptive of respiration.

Upon the amount of air contained in the lungs an opinion is based respecting the completeness of respiration or the length of time it has continued. If all the pieces float before and after being squeezed or compressed, respiration was probably complete and lasted for some time; if some sink while others float, the respiration was less perfect or lasted only a shorter time.

The hydrostatic test therefore proves the presence or absence of air in the lungs, and justifies an opinion as to the probability or otherwise of respiration having taken place and the degree of perfection to which it attained. It is not an absolute test of live-birth, for the child may have been born alive and not have breathed, or it may have breathed so imperfectly that no appreciable distention of the air-cells can be demonstrated post mortem, or air may have entered some cells for a time and have been absorbed or aspirated out before death took place, leaving the lungs as airless as in the fœtal state. On the other hand the child may have breathed during its birth and died before it was completely born. The charge of infanticide may hold even when the hydrostatic test gives no evidence of respiration, or it may fall through even though the hydrostatic test proves respiration to have taken place.

OBJECTIONS TO THE HYDROSTATIC TEST.—1. The lungs of children which have breathed may sink from (*a*) atelectasis, (*b*) disease.

2. The lungs of children which have not breathed may float from (*a*) artificial inflation and respiration, (*b*) the presence of putrefactive gases, (*c*) emphysema.

1. LUNGS WHICH HAVE BREATHED MAY SINK.—*a. Atelectasis*: The lungs remain almost or wholly in the fœtal condition. In Albert's[1] case, the child lived for thirty-six hours and had several convulsions. Post mortem the whole of the right and the lower portion of the left lung were in a fœtal condition and sank in water. There was no disease present, and the unexpanded portions could be easily inflated.

Or there may be complete non-expansion although the child has lived and breathed feebly. This is most apt to occur in premature children. Remer[2] reports a case in which the lungs sank in water, although the child had lived four days and the cord had separated naturally. Orfila describes a post mortem on a child which had lived for eleven hours; every portion of the lungs sank in water. Vernon[3] was called to a woman at the end of her sixth month; when he entered the room he heard the child crying under the bed-clothes. After it was separated from the mother, it apparently breathed naturally and cried at intervals, but died in five hours from exhaustion. It weighed 2 pounds 13 ounces; the lungs were non-crepitant and sank in water. Donders[4] was misled by the fœtal condition of the lungs in a seven-months child and gave it as his opinion that it had died in utero a short time before birth, whereas it had really been born alive, had cried distinctly after its birth, and lived for twelve hours. Many similar cases[5] are recorded, and noticed by Hofmann, Liman, Taylor, Tidy, Ogston, Guy, and other writers on medical jurisprudence. (See case 4.)

When air is not found in any portion of the lungs in such cases it is impossible to determine from the lungs whether the child was born alive or dead.

b. Disease may consolidate the air-cells and prevent the entrance of air, as in œdema, congestion, hepatization, scirrhus, etc. It is very unlikely that both lungs would be affected in every part—some cells would be found inflated if the lungs are carefully examined; moreover, the well-known appearances characteristic of these affections would be easily recognized by the pathologist. In criminal cases, it is always necessary to exclude disease as a possible cause of airlessness. (See cases 6, 7.)

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[1] Hencke's Zeitschrift, 1837, ii., 422.

[2] Hencke: "Lehrb. d. ger. Med.," 374.

[3] Lancet, 1855, i., 121.

[4] Dublin Med. Press, November 22d, 1865, p. 456.

[5] See Lancet, 1872, i., 227; Guy's Hosp. Reports, 1837, ii., 346, 355; Annales d'Hyg., 1878, ii., 489; Lond. Med. Gaz., xxxix., 283.

2. Lungs which have Not Breathed may Float.—*a. Artificial inflation and respiration* may produce appearances similar to those of natural respiration. Practically in criminal cases, little weight need be attached to this objection, for artificial inflation would most likely be practised by the medical attendant or the mother to save the child's life. Presumably any person attempting to destroy a new-born child would seek to prevent respiration rather than to establish it, to maintain the lungs in their fœtal state rather than to inflate them with air, to create a presumption of dead-birth rather than live-birth.

While it is easy enough to inflate a lung artificially outside the body, it is by no means easy to do so *in situ*, especially if the person attempting inflation is unskilled and ignorant of the anatomy of the parts. Many medical jurists deny the possibility of perfect inflation by mouth or tube.

It is proved by experiment that in insufflation by the mouth-to-mouth method, or by a canula passed into the child's mouth, more air is forced into the stomach and intestines than into the lungs. The stomach and intestines of dead-born children are airless and sink in water, and can therefore be easily distinguished from the bloated, distended condition which follows artificial inflation.

Inflated lungs contain air, but they are comparatively bloodless, for the establishment of the pulmonary circulation is coincident with respiration.

Kotelewsky[1] claims that the injection of the interalveolar vessels taken along with rose-colored marbling of the lungs is characteristic of respiration, and that absence of these appearances proves that any air which is present has been introduced artificially. This view is not correct, because there is more or less blood in the interalveolar and interacinous vessels, even in children born asphyxiated, and if air is blown in forcibly there will be more or less rose-colored marbling. The more blood there is in the vessels the more perfect the marbling. Emphysema is apt to occur after inflation either on the surface of the lungs or interstitially from over-distention and rupture

[1] Wien. med. Blätter, 1882, No. 18.

of the air-cells by the excessive force employed. Yet it must be borne in mind that interstitial emphysema might be due to other causes. It is much easier to squeeze the air out of an artificially inflated lung than out of one which has been distended by natural respiration. It is easy to distinguish an inflated lung from one that has been completely expanded by respiration; but it is far more difficult to make a diagnosis if the distention has only been partial.

Air may be forced into the lungs of still-born or dead-born children by the violent use of Schultze's or Pacini's[1] method of performing artificial respiration. This has been the subject of much controversy on the continent, especially in Germany. Hofmann[2] doubts whether air gets into the lungs after Schultze's swinging as easily as affirmed by Runge and others.[3] But so many cases have been reported, that there can no longer be any doubt that air may be forced into the lungs by the violent or prolonged use of Schultze's method. (See cases 23–28.)

Besides forcing air into the lungs, Schultze's method may cause serious internal injuries, such as rupture of liver, spleen, heart, or kidneys, and may even fracture the ribs or other bones. Runge[4] cites a case in which a child twelve days old died of diarrhœa and vomiting. He compared the lungs with those taken from a dead-born child which had been subjected to Schultze's swinging. The lungs of both children gave the same appearance in respect of color, distention with air, marbling, bloody froth in smaller bronchi, etc., so that no one could tell from their appearance which were the lungs of the dead-born child. If the child is premature and a small number of swings given, the air may not enter the lungs, or may do so to a very slight degree. But even if air does enter the lungs as the result of artificial respiration, there is never the uniform distention which occurs after natural respiration. In one case mentioned by Pellacani, 163 respiratory movements were made and the lungs were only incompletely filled with air.

b. Putrefaction.—The possibility of putrefactive gases being the cause of the lungs floating is only admissible when the body shows elsewhere the signs of advanced decomposition, and when there is undoubted evidence of putrefaction in the lungs.

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[1] Virchow's Jahrb., 1889, 1.

[2] See Wien. med. Blätter, 1884, No. 34; Wien. med. Wochensch., 1885, No. 10.

[3] Wien. med. Blätter, 1884, No. 29; *ib.*, 1885, No. 1; *ib.*, 1885, No. 8; Wien. med. Wochensch., 1885, No. 8; Deutsch. med. Zeitung, 1886, No. 1; Vierteljahrsch. f. ger. Med., xlii., 1; *ib.*, xliii., 253; *ib.*, N. F., iii., 29.

[4] Eulenberg's Vierteljahrssch., N. F., xlii., 41.

The lungs *in situ* are slow to decompose, and if the hydrostatic test is carefully used, there should be very little chance of error. Ogston in 52 cases (in some of which the child had been dead for five months) found none where it was difficult to use the hydrotastic test on account of putrefactive gases.

When lungs begin to decompose they change color from imbibition and the conversion of hæmoglobin into methæmoglobin and then into hæmatin. (Fig. 3, Pl. IV.) The first blebs appear in the blood of the large vessels, which becomes frothy. Then they are observed singly and in groups in parts of the lung where there is blood-imbibition. Air-bubbles are visible under the pleura, which they presently lift up into larger or smaller blebs. If the larger ones are punctured, the air escapes. In the earlier stages of decomposition, pricking the blebs may cause the lung to sink, but when decomposition is far advanced and the lungs are pulpy, putrefactive blebs may be found in lungs which have breathed, and the lungs may sink when the blebs are punctured.

Putrefaction never causes the uniform distention which is found after natural breathing or inflation. Hofmann mentions a case in which an autopsy was made on a woman who had died of uterine rupture during labor. Putrefaction was far advanced, and in the abdominal cavity was found a child much decomposed. Not only the child's liver, spleen, kidneys, stomach, and intestines floated, but its whole body as well; yet the lungs were fœtal in appearance and sank when placed in water. In selecting a portion of lung for the hydrostatic test where putrefaction has begun, it is well to take it from the centre of the lung and not from the surface.

c. Emphysema has been suggested as an objection to the hydrostatic test. But no case has yet been reported in which emphysema developed spontaneously in fœtal lungs where labor had ended without assistance. But even if emphysema did occur, the air could be dislodged by pressure and the appearances would not resemble those which follow natural breathing.

d. Freezing and alcohol.—In the winter season or in cold climates it is worth remembering that even airless lungs may float when frozen, but they sink after being thawed out. It is also to be noted that lungs which have been lying for some time in alcohol may float, but if they are left in water till the alcohol is extracted they sink.

It is evident therefore that the hydrostatic test is fairly reliable and enables us to say in most cases whether respiration has taken place or not if the presence of air is demonstrated in the lungs. But what conclusions can we draw if the lungs are found to be airless? In the great majority of cases it may be affirmed that the child was born dead. Exceptional cases may be explained in one of three ways:

(1) The child though alive may not have attempted to breathe.

(2) It may have tried to breathe, but the air was prevented from entering its lungs.

(3) Air may have entered the lungs in small quantity and subsequently disappeared.

(1) Before the 28th to 30th week the fœtus is so immature that, although born alive, it may be unable to breathe from weakness of the respiratory muscles and lack of development of the respiratory centre. If a little older, it may live and breathe superficially for a time and even cry, but does not seem to have power enough to dilate the air-cells; the respiration is bronchial, death occurs within twenty-four hours, and the lungs are found airless.

Sometimes the child is slow in beginning to breathe, opening its eyes and looking around for a minute or two before making a respiratory effort. In such cases a modified placental circulation is generally going on, and CO_2 has not accumulated in sufficient quantity in the blood to excite the respiratory centre, but the heart-beat is usually strong and regular, while in asphyxia it is apt to be weak and irregular; the former is a condition of apnœa, the latter one of asphyxia, and the diagnosis is not difficult.

Occasionally compression of the brain from extravasation of blood beneath the membranes may retard or prevent respiration. The commonest cause is asphyxia. Presence of life is indicated by the heart-beat and feeble attempts to breathe or move. It is impossible to tell from the appearance of the child whether the case is hopeless, or whether the asphyxia may be overcome by proper treatment; in the most promising cases we sometimes fail, and in apparently desperate ones we sometimes succeed. It is therefore impossible for a medical witness to say in the case of a child which was born alive and died asphyxiated, that it would have lived had proper means been employed to resuscitate it.

(2) The child may have attempted to breathe, but the entrance of air may have been prevented either accidentally or by violence. The membranes may cover the mouth and nose, or foreign matters may enter the respiratory passages during the progress of birth (meconium, mucus, or liquor amnii), or congenital disease or deformity may cause a mechanical obstruction to the entrance of air.

There is usually very little difficulty in diagnosing such cases; but when air has been excluded accidentally or intentionally, the diagnosis is more difficult. The child may lie face downward in a pool of blood or discharges, or it may be born into a bucket or bath of water; its head may be closely enveloped with bedclothes, its face compressed by the mother's thighs, the mouth and nose kept forcibly closed, or its neck constricted by a coil of the umbilical cord, or a garter, handkerchief, string, or other ligature. The constriction may be accidental or applied with criminal intent. In new-born children the heart may beat for some time although respiration is not established, and as long as it beats there is chance of resuscitation. (See cases 8, 11, 18, 19, 20, 29.)

The heart is frequently found beating half an hour after birth, occasionally as long as two hours. New-born animals have lived twenty-eight to thirty-six minutes under water; grown animals would have perished in three minutes. Hofmann has found the heart beating five hours after birth in animals.[1] Maschka describes a case when the heart-beat was detected by auscultation twenty hours after the new-born child had been laid aside as dead; in another, life was not extinct five hours after the child had been buried under a foot of earth. Bardinet's case was alive after being buried for eight hours under ten inches of ground.[2] The cause of such great resisting power in new-born children has not yet been satisfactorily determined, although many explanations have been proposed.

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[1] Wien. Med. Pres., 1878, No. 10.

[2] Schmidt's Jahrb., 1874, p. 9; Med. Centralb., 1880, p. 462.

(3) Lungs which have contained air may subsequently lose it. Through the elasticity of the lung-tissue more air may be expelled during expiration than is replaced during the succeeding inspiration. In this way the lung may empty itself more or less completely of its contained air. Prof. Arrigo Tamasia[1] has shown by experiment that a lung left to itself will in no case lose air spontaneously to such an extent as to sink to the bottom when placed in water. Ungar's[2] explanation is that the air is absorbed by the blood circulating in the pulmonary capillaries. Seydel[3] reports a case in which a premature child (about the thirty-second week) was born alive; there was great difficulty in establishing respiration, but it finally breathed well and cried. It was put to the breast and nursed, and then laid in a cradle with its head uncovered; it died in four hours. On section the lungs were found to be nearly airless, and no piece could be got to float. A few bubbles and a little froth were squeezed into the trachea by pressure of the lung. The lungs were dark blue, with smooth surface and numerous dark subpleural ecchymoses.

From these considerations it is evident that live-birth cannot be positively affirmed because the lungs contained air nor dead-birth because they were airless. The post-mortem examination of the lungs gives no signs by which live-birth may be positively affirmed or denied.

Changes in the Cord.—Shortly after the cord is ligated and cut, changes begin to take place in the stump. It loses its shiny, polished appearance and becomes dull in color, a line of demarcation forms, it slowly dries, shrivels, and separates in four or five days by dry or moist gangrene. Meanwhile the umbilical vessels have become occluded, and the stump is completely healed when the cord drops off, or cicatrizes in a few days. Pulsation of the cord after the child is completely born is a positive sign of life. If the cord is not tied, pulsation usually continues for two or three minutes or even longer if the placenta remains attached to the uterine wall, and a modified placental circulation persists for a time.

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[1] Riv. Sperim. di fren. e di med. leg., viii., 4 (med. leg.), p. 525, 1883 (Schmidt's Jahrb.). Cf. Vierteljahrs. f. ger. Med., xix., 246.

[2] Eulenberg's Vierteljahrssch., N. F., xxxix., 12, 213.

[3] Eulenberg's Vierteljahrssch., 1891, ii., 5.

When the cord separates by dry gangrene it is said to mummify. This is most apt to occur if the cord is thin and contains but little Wharton's jelly, and if it has been wrapped up and kept dry and warm. The formation of a line of demarcation is a sign of vital reaction signifying that the living is separating the dead and casting if off. A microscopic examination of the tissues of the cord (especially the vessels) may help to determine how long the child has lived. In strong full-term children the cord separates sooner and better than in delicate, premature children.[1] In the Montreal Foundling Hospital, a child died on the seventeenth day from abscess of the sternum, the result of purulent pericarditis. The cord had not yet come away, and there were no signs of inflammation about it.

The umbilical arteries usually begin to contract in twenty-four hours, the vein somewhat later. But variations occur so frequently that little reliance can be placed upon these changes for medico-legal purposes.

Closure of the foramen ovale and obliteration of the ductus arteriosus and ductus venosus are signs of live-birth which have been studied a great deal on the Continent; indeed an abundant literature has sprung up about the "*docimasia circulationis*," as the examination of these fœtal structures is called. But the value of such evidence is only corroborative; patency of all three does not necessarily imply that the child was born dead, nor is the immediate or early closure of any or all of them necessitated by live-birth. Normally they are rarely obliterated before the eighth to tenth day, sometimes not till the sixth to eighth week, and occasionally the foramen ovale never closes. The order of obliteration is not always the same.

Changes in the Skin.—The skin of the new-born child is described as passing through certain color-changes which not only denote life but also give some idea of the age. Dark red at first, in an hour or two it becomes light red, darkening again in a couple of days; it often becomes more or less yellow, and in seven or eight days finally settles down into the normal reddish-white color it afterward maintains. Desquamation of the epidermis usually occurs, but does not follow any regular order or last any definite time. Little reliance can be put on these color-changes for medico-legal purposes.

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[1] The condition of the navel is not always a proof of the age of a child. Loviot records a case where the cord did not fall till the seventeenth day. Archiv. de Tocol., xvii., 411.

Middle-Ear Test.—In 1868 Wreden stated that the pad of epithelial cells and fœtal jelly, which fills the cavity of the tympanum in the mature fœtus, retrogrades and retracts during the first few hours after birth so that the tympanum contains air. Wreden and Schmaltz[1] consider it of importance medico-legally to determine whether the tympanum and Eustachian tube are airless or not. Presence of air implies respiration, but then more reliable evidence is obtainable elsewhere. Middle-ear changes may appear in a few hours or not for several weeks; their absence is no proof that live-birth has not taken place.

Changes in the Liver.—The liver shrinks after birth and becomes lighter. Bernt of Vienna proposed the loss of liver weight as a test of live-birth. It is not reliable, for there is no means of knowing the weight of the liver before birth, and consequently no means of determining its loss of weight after birth.

Changes in Bladder and Kidneys.—It has been stated that a full bladder signifies dead-birth, an empty bladder live-birth. This test is worthless, for not only may a live child retain its urine for some hours after birth, but the bladder may be mechanically emptied during labor and the child be subsequently born dead.

Uric-acid infarction in the kidneys has been claimed by some German authorities to be a positive proof of life. Vogel says that it is as positive a sign of life as dilatation of the lungs with air. The deposit consists of golden-yellow streaks of crystallized uric acid, most abundant in the papillæ of the kidney, deposited there because sufficient water has not been excreted to wash it away. Engel says that uric-acid crystals are rarely found in the kidneys of children that have breathed for a whole day. This does not correspond with our own observations in this city. In the post-mortem examinations made at the Montreal Foundling Hospital, uric-acid infarctions have been very frequently found in the kidneys of children dying of marasmus, up to the age of four months.

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[1] Lancet, 1877, ii., 741.

Subsequent observations have failed to substantiate the claims made by the promoters of this test, and it cannot be considered reliable.

Changes in Stomach and Intestines (BRESLAU'S TEST).—The stomach and intestines of the unborn fœtus are as airless as its lungs; but as soon as respiration begins, air enters the stomach and spreads gradually down through the bowels. It is not yet determined whether the first air-bubbles in the stomach are produced by efforts to swallow or by the aspiration of air.

In 1866 Breslau[1] proposed a hydrostatic test for the stomach and intestines similar to that used for the lungs, and claimed that the amount of air contained and the distance to which it penetrated are proportionate to the extent and duration of respiration. His conclusions have been verified in the main by numerous observers.

In the majority of cases, coincident with the first breath of extra-uterine life, air enters the stomach and enables it to float on water. Occasionally it happens that the stomach and intestines do not float though the child has lived and breathed after birth, just as exceptionally the lungs are found airless under similar circumstances.

This test has been found particularly useful where air has been prevented from entering the lungs by foreign bodies or occlusion of the bronchi. When respiration is impeded or imperfect, air enters the stomach in larger quantity and extends farther down into the intestine than when respiration is fully and speedily established.

Besides air, foreign bodies (sand, earth, meconium, liquor amnii, etc.) may be drawn into the stomach by the active swallowing movements which a child makes when it is suffocating. In a new-born child which had been buried, Maschka[2] found earth in the stomach and streaks of it in the intestine.

The objections to this test are that air may get into the stomach and intestine of dead-born children, and that it may disappear from those of live-born children. Winter[3] reports nine cases in which more or less air was found in the stomach (and twice in the intestine) of undoubtedly dead-born children. It must have got there before birth. Air may be forced into the stomach by artificial inflation or by the use of Schultze's method of artificial respiration, provided there is communication between the intrathoracic œsophagus and the outside air. Air may be absorbed or may be forced out of the intestine and stomach by peristaltic action.

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[1] For a full discussion of the explanations offered by Breslau, Kehrer, and Ungar, see Vierteljahrssch. f. ger. Med., xlviii., 234; also Falk in Zeitschrift f. Geb. und Gyn., xiv., Hft. 1.

[2] Vierteljahrssch. f. ger. Med., xlv., 242.

[3] *Ibid.*, li., 101.

The positive results of this test are inferior to those of the hydrostatic lung test when decomposition is well advanced, for putrefaction occurs sooner in the stomach and bowel and advances more rapidly than in the lung, especially if meconium or liquor amnii has been swallowed. Nikitin[1] says that in 100 cases in which this test gave positive results, the lung test was negative in five cases; in two of these cases the child was known to have lived, in the other three it was not known. He had one case in which the child lived five days and at the post-mortem examination the stomach and intestines were found airless. Wendel[2] reports a case where a child lived eleven hours, and the stomach and intestines were found airless.

In order to determine how far air has penetrated into the intestinal tube, the rectum should be ligated before the bowel is removed from the body, and the floating capacity tested piece by piece beginning at the rectum.[3] This test cannot replace the hydrostatic lung test, but it may substantiate and enlarge or even correct the evidence afforded by the older test; it should not therefore be omitted or neglected. It is best to tie the stomach at the pylorus so that stomach and intestines may be removed separately, and it may be more easily determined how far the air penetrated into the bowel.

An examination of the contents of the stomach sometimes gives important information. Meconium, blood, urine, liquor amnii and other matters may be detected in the stomach as well as the respiratory passages during the post-mortem examination. Their presence indicates that the child was alive at or shortly before its birth, but does not prove live-birth. It is otherwise if the liquid or foreign matter is of such a nature that it could only have been swallowed after birth; then its presence in the stomach is a proof of live-birth. A woman was delivered suddenly while sitting over a bucket of dirty water; though the child's lungs were airless, some of the water was found in the stomach. Although it did not breathe, it must have been born alive, else it could not have swallowed some of the water into which it fell.

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[1] Vierteljahrssch. f. ger. Med., xlix., 282.

[2] Inaug. Dissert., Dorpat, 1891; "Ein Beitrag zur Lehre vom Kindesmorde."

[3] Körber: "Sectionstechnik für neugeborene Kinder," Dorpat, 1888, p. 83 *et seq.*

The meconium is odorless and of a dirty green color, and is normally found in the large intestine; in order to get into the stomach, it must have escaped into the maternal passages during labor, and then been swallowed during premature attempts at respiration.[1]

Before birth the fœtal stomach contains mucous or albuminous matters; gastric juice does not appear till after respiration. If any foreign matters or foods are found in the stomach, they must have been swallowed, but not necessarily after the complete birth of the child. Starch, sugar, and milk are the commonest foods found in the stomach, with or without an admixture of pavement epithelium from the mouth and passages. Starch is recognized by its microscopical appearances and its reaction with iodine. If a fragment is treated with a few drops of distilled water, and a drop or two of iodine solution added, the characteristic blue color will be developed. The various kinds of starch are easily made out under the microscope, and may be detected in smaller quantities than are ascertainable by chemical tests. Sugar is readily recognized by the ordinary chemical tests. Milk and colostrum are discovered by the microscope; it is not generally possible to distinguish human breast-milk from that of the domestic animals.

The positive recognition of meconium may have an important bearing in determining the question of live-birth. Some apparent confusion exists among authors as to the appearance and constituents of meconium. Huber[2] attributes this to the non-recognition of the fact that meconium is found in two distinct forms which may exist separately or together.

(1) *Dark-green*, ropy, richer in mucus and the yellowish-green oval bodies which give it color and are characteristic. (Fig. 30, *a*.)

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[1] Viertelj. f. ger. Med., 1863, i., 97; also Med. Times and Gaz., ii., 116.

[2] Friedreich's Blätter, xxxv., 24.

(2) *Yellowish-brown*, containing yellowish epidermis cells, numerous cholesterin plates, fatty cells, and lanugo hairs derived from liquor amnii which has been swallowed. (Fig. 30, *b*.)

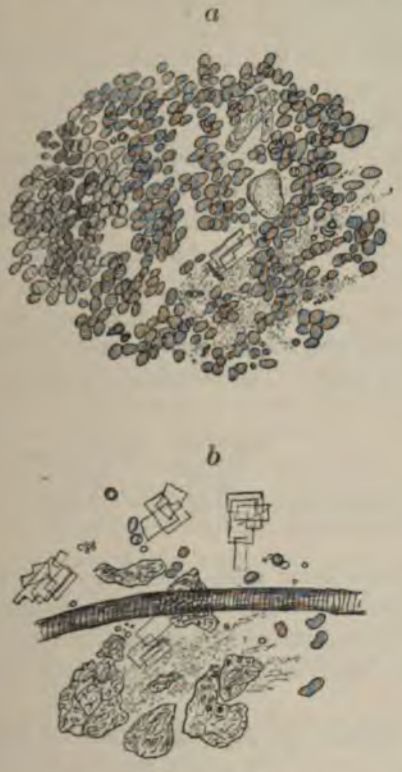

FIG. 30.

Tardieu figures these yellowish bodies ("Étude Médico-légale sur l'Infanticide," 1880, p. 369).

Stains of meconium on the clothing are sometimes important.[1] They are brownish-green, stiffen the fabric, are raised above the surface but do not always penetrate deeply into it. With water they form a greenish solution which is acid and unaffected by boiling. If the stains have been made by fæcal matters, the color, odor, and reaction give evidence as to the age of the child.

[1] Fried. Blät. f. ger. Med., 1884, 24, 142.

Iron-lung Test (ZALESKI'S TEST).[1]—Non-breathing lungs are not functioning and are in the fœtal condition. They contain only sufficient blood for their nourishment and growth; but when respiration begins, a larger quantity of blood is directed to them. As there is more blood in the lungs after respiration than before, and as iron is a constituent of the blood, there must be more iron in lungs which have breathed than in those which are in the fœtal state.

Zaleski claims that it is possible to determine live-birth in doubtful cases by a quantitative analysis of the blood found in the lungs. He directs the lungs to be carefully ligatured and removed, washed and tested by the hydrostatic test. They are then to be dried, weighed, and exposed to an air-bath of 115°–120° C., the dry residue weighed and reduced to ashes, and the amount of iron determined as well as its percentage to the weight of the lung. The following table shows his results:

	Dead-born. Per cent.	Live-born. Per cent.	For live-born children or adults. Per cent.
Dry matter	13.22	15.87	16.86
Proportion of Fe to fresh lung.	0.011–	0.0188–	0.0217
Proportion of Fe to dry lung .	0.0828–	0.1182–	0.1266

Zaleski's results have been questioned by Jolin and Key-Aberg of Stockholm.[2] They examined eighteen cases of children who died before, during, immediately after, and some time after birth, and found that no such constant relation exists as stated by Zaleski.

The Bacteriological Appearances of Putrefaction.—This is the most recent test which has been suggested for distinguishing a child which was born alive and breathed from one which was born dead. Dr. Malvoz of Liège has investigated this subject, and his observations were communicated recently to the Academy of Medicine of Belgium.[3] It has been frequently observed that, other things being equal, putrefaction runs a different course in a new-born child which has lived and breathed, than in a fœtus which has perished before, during, or immediately after birth without breathing. The micro-organisms are different, attack the organism in a different way, and produce different results. In dead-born children putrefaction begins in those parts of the body which are in contact with the outside air, and is effected by means of the ordinary bacilli found in animal decomposition (bacillus fluorescens, proteus, etc.). In children which have lived and breathed, air enters the stomach and intestines, and putrefaction begins in the intestines; the active agents belong to the family of the coli-bacilli. If these observations are confirmed, a bacteriological examination will afford valuable information which may be decisive in some cases of infanticide.

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[1] Vierteljahrssch. f. ger. Med., xlviii., 68.

[2] Vierteljahrssch., li., 343.

[3] "Recherches bactèriologiques sur la Putréfaction des Nouveau-nés et leurs Applications médico-légales;" Academie de Médecine de Belgique; Séances des 28 Octobre et 25 Novembre, 1893; La Semaine Médicale, 6 Dec., 1893.

II. IF THE CHILD WAS BORN ALIVE, HOW LONG DID IT LIVE AFTER BIRTH?

In some countries the law holds the destruction of the child immediately or shortly after birth to be a less serious crime than its cold-blooded murder hours or days afterward. Pain, excitement, and mental anguish are considered as mitigating circumstances, especially in the case of illegitimate children. Such excitement may last for hours or even much longer in exceptional cases. It is not safe to set any time limit in such a matter; each case must be judged upon its own merits. A medical expert should be very careful how he testifies to a mother's responsibility or irresponsibility for the destruction of her new-born child, unless he has personally seen her behavior at and after her confinement.

In order to estimate the length of time a child has survived its birth, attention must be paid both to external and internal appearances.

EXTERNALLY, the fouling of the body with blood and maternal discharges would probably indicate that the child had not been washed; but such appearances would be absent if the child had been born into water or put into water immediately after its birth.

Much more weight can be attached to the presence of vernix caseosa in the axilla, inguinal region, or folds of the neck. The vernix is not very easy to remove and may remain a day or more; if present it denotes with tolerable certainty that the child is new-born. Its absence does not prove that the child was not new-born, for some children are born with little or no vernix.

The color of the skin and the extent of exfoliation may give some assistance in forming an opinion, but too much stress must not be laid upon these appearances.

The appearance of the caput succedaneum gives valuable information when it is present; but its absence means nothing, for labor may have been rapid and easy and no caput may have formed.

The most reliable information is obtained from the navel and stump of the cord. The child is new-born if the cord and placenta are still attached, or if the cord has been divided and the portion attached to the child looks fresh and unchanged. If the child lives, the cord soon shrinks, shrivels, and mummifies, the drying process starting at the free end of the cord. From the second day the line of demarcation is usually apparent and the dead gradually separates from the living, the vessels being the last to give way. After the cord falls there is contraction of the ring, and retraction of the arteries. It must not be forgotten that in the dead body of a new-born child decomposition goes on rapidly in the cord, and that if exposed to the open air or a dry atmosphere it dries as quickly as in life. The time at which the cord separates naturally, varies from two days to two weeks or more. In Loviot's[1] case, the cord did not fall till the seventeenth day. The condition of the navel therefore is not always a proof of the child's age. A cord which has already hardened may soften, swell, and become fresh-looking if the body is wrapped in wet clothes or is lying in water. The cord may be torn away from the child's body accidentally during birth, or purposely afterward. In the fresh state, the appearance of the umbilical wound, the condition of the vessels, and the presence of shreds of amnion would make the diagnosis easy; but if decomposition be far advanced, no positive conclusions can be drawn. From the appearance of the navel and cord in the fresh state, it is generally possible to say that the child was less or more than two days old when it died; but it is difficult to say whether the child died immediately after birth, or to fix the time of its death within the two days.

INTERNALLY, the appearance of the lungs may give some evidence respecting the length of time the child has lived. A condition of atelectasis is generally presumptive of a relatively short life. Yet it must be remembered that one or two good breaths may suffice to send air into all parts of the lungs, and on the other hand that marked atelectasis may exist in children which have lived for several days or weeks.

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[1] Archives de Tocologie, xvii., 411.

The condition of the stomach and intestines may give important information. If air has entered the stomach and penetrated deeply into the intestinal tract, and if artificial inflation and putrefaction can be excluded, it is safe to conclude that the child did not die immediately after its birth. The presence of meconium in the large intestine generally means death very soon after birth; the presence of food shows that it lived long enough to be fed.

Some authors have laid stress upon the size of the ossification centres in the lower epiphysis of the femur and the head of the humerus, but no positive conclusions can be drawn from them respecting the age of the child. If the child is congenitally feeble and is not properly nourished after its birth, it may not develop, and ossification may not advance. Dr. Johnston of Montreal reports the case of a child examined by him at a coroner's inquest, in which there was no point of ossification in the femoral epiphysis, though the child was six weeks old. It died of broncho-pneumonia.

It will thus be seen that we have no certain means of determining how long a child has lived after its birth; but an approximate idea may generally be gained by a careful consideration of all the external and internal appearances.

III. WAS DEATH DUE TO NATURAL CAUSES OR TO VIOLENCE?

Death may occur during or after birth, and in either case it may be due to natural or unnatural causes. Since many children die either in the process of birth or afterward from natural causes, the law presumes a natural cause for death till the contrary is proven. The onus of proof is therefore thrown upon the prosecution.

It has been estimated that still-birth occurs once in every eighteen to twenty cases among legitimate children, once in every eight or ten among illegitimate and immature children;

it is in these latter cases that charges of infanticide are most frequently brought. Still-births occur oftener in primiparæ than multiparæ, oftener among male children than female. Infanticide is generally in primiparæ. A child may have been alive during its birth or when born and may die afterward from natural causes. It may have breathed during or after birth and yet die afterward from natural causes.

NATURAL CAUSES—CAUSES OTHER THAN VIOLENCE.

If the child was dead-born, the cause was most likely natural. If it was born alive and survived for a time, and there were no marks of violence on the body and no poison in the stomach, the cause was probably natural. Nevertheless it may have been destroyed intentionally by exposure, neglect, or omission, or by closure of the mouth and nose to prevent the establishment of respiration.

Though the medical evidence may be unable to establish the fact of criminal neglect or interference, it may be able to show whether the explanations given by the accused as to the mode of death are consistent with the facts, and whether her story is true or false. Again, even if there are marks of violence on a child found dead, they may not have been the cause of death, or they may have been produced accidentally or after death. The following questions may arise in such a case:

(1) Might the marks of violence have been produced by the mother while trying to deliver herself?

(2) Might they have occurred accidentally or unavoidably in the course of an unexpected confinement?

(3) Are they so situated and of such a nature as to indicate intentional and consequently criminal violence?

(4) Might they be due to some malformation?

(5) If the body was exhumed might they have been inflicted during exhumation?

Protracted labor is one of the commonest causes of fœtal death. If the uterine contractions are strong and without intermission, a sufficient quantity of maternal blood may not enter the placenta to maintain the child's life; or the placenta may be partially separated by uterine action and thereby disabled; or the cord may be compressed and the fœtal circulation thereby embarrassed. When the labor is difficult and prolonged, the caput succedaneum is usually large, and the head moulded into the shape characteristic of the presentation and position. The child's death is more apt to occur from such causes if the mother's pelvis is deformed or the soft parts contracted and unyielding, or if the child is very large or deformed, or the cranial bones much ossified. Yet death may occur from natural causes though the fœtus and maternal passages are apparently normal. In such cases the cerebral vessels may be found congested, or an extravasation of blood beneath the meninges. Dr. Wyatt Johnston has pointed out that cerebral hemorrhages may be found post mortem in a macerated fœtus as well as in one still-born. He has also noticed that these blood-clots usually remain firm and persist after the surrounding cerebral tissue is far advanced in decomposition.

Debility.—Immaturity is a common cause of fœtal death during or shortly after birth. The more immature the child the less probability is there of live-birth or the continuance of life after birth. Atelectasis is common in immature children. Though born alive, they may not have sufficient vitality to start the respiratory process without help, and it sometimes requires long and persistent work to establish respiration. If such help is not given the child soon dies, or it may breathe feebly for a few hours or days and finally perish. The immaturity of the child and its inability to breathe properly, are quite evident in such cases. If it is mature and well-developed, and the post-mortem shows that the lungs have been well expanded, the plea of congenital debility would not hold as a cause of death. Holowko[1] records the case of a child born alive in the twenty-seventh week of pregnancy; it measured 37 cm., and weighed 1,300 grammes. Hubbard[2] reports the birth of a very small living child; it was 10 inches long, weighed 18 ounces, the circumference of its head was 8 inches; it lived eight hours. Ahlfeld reports cases of children born at the twenty-seventh and twenty-ninth week which lived. D'Outrepont's case, born at the twenty-fifth week, lived.

When a premature child lives, breathes, and dies in a little while, the question may arise whether death was due to immaturity and weakness, or to difficulties during birth, or to suffo-

[1] Centralb. f. Gyn., 1890, 235. [2] New York Med. Journal, 1890, 491.

cation. The details of such a case are published by Dr. Wollner[1] and the various points fully discussed.

Congenital malformations anywhere or of any vital organ, malformations of blood-vessels, congenital absence or imperfection of any vital organ, imperforate anus or urethra, malformations of the pharynx, œsophagus, or stomach, an enlarged thyroid causing suffocation from pressure, fixation of the epiglottis so as to prevent the entrance of air to the lungs, etc., may cause death.

Monsters usually have feeble vitality and soon perish; but it is illegal to destroy a monster or hasten its death. The experience of medical jurists and obstetricians proves that in many instances the possibilty of independent life is not necessarily destroyed by congenital head monstrosity (micro-, meso-, and hydro-cephalic). A peasant-woman bore a child at full term without assistance. A peculiar deformity of the head was noticed. The child showed signs of life, moved its limbs, and made sucking movements with its mouth. It died in ten minutes after birth. It was found to be an anencephalic monster; the bones of the cranial vault were completely absent, the base of the skull was raised upward and covered with a thin reddish-white pia-mater, the spinal axis was intact. The lungs were airless but moderately full of blood.[2] Fritsch[3] publishes a case in which after perforation, excerebration, and extraction, the child lived for an hour and a half, breathing superficially. The post-mortem showed the lungs to be airless.

Monsters do not necessarily die immediately after birth. Taylor reports two cases: one was a child with two heads; the other was a hemicephalus which was born alive and destroyed by a woman attendant. In Braun's clinic, a hemicephalus lived seven days. Another case of marked microcephalus with arrested development of the cerebrum and an anterior double encephalocele, which could scarcely have been called viable in the ordinary sense of the term, was born alive and died from suffocation in a privy.[4]

Disease may destroy the child's life in utero or render it incapable of living after birth. High fever in the mother, as in the zymotic diseases, is rapidly fatal to the fœtus. Syphilis, cancer, albuminuria, phthisis, and other constitutional disorders are slower in their action but equally fatal. Disease in the fœtus, such as hepatization of the lung, fœtal pneumonia, atelectasis, pulmonary apoplexy, collapse of the lung from pleuritic effusion, apoplexy, softening of brain and cord, sepsis, erysipelas, rickets, fatty degeneration of the heart, spasm of the laryngeal or respiratory muscles, may destroy life. There should be no difficulty in recognizing such gross pathological conditions.

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[1] Friedreich's Blätter f. ger. Med., xxxv., 111.

[2] Vierteljahrsschrift, 1891, ii., 190.

[3] Centralb. f. Gyn., 1891, No. 9, 176.

[4] Hofmann's "Lehrb. d. ger. Med.," 780.

Hemorrhage may occur from the cord, stomach, genitals,[1] rectum; it is most apt to appeaar in the children of *bleeders*, on account of the imperfect coagulability of the blood. In such cases bleeding is apt to recur from time to time till death ensues.

The free end of the umbilical cord is the commonest site of hemorrhage in new-born children. The cord may not have been tied after being cut or torn, or it may have been imperfectly or improperly tied, or the ligature may have slipped or been removed purposely, or the ligature may have stretched or the cord shrunk. The sooner the cord is cut after birth and the nearer to the abdomen, the greater will be the probability of hemorrhage. A cord that is cut with a sharp knife is more likely to bleed than one cut with a dull knife or scissors, or one that has been torn or ruptured. The ligature is less likely to hold securely and constrict the vessels if the cord is bulky and contains much Wharton's jelly, than if it is thin and small.

If respiration has been well established, dangerous hemorrhage is not apt to occur; yet fatal cases have been recorded, two having come under my own observation. Hemorrhage may occur without interfering with respiration; and if respiration is absent, feeble, or arrested from any cause, the probability of hemorrhage will be greater. There may be fatal bleeding from the stump after separation of the cord, especially in cases of hæmophilia.[2] Accidental rupture of the cord may be followed by hemorrhage in exceptional cases.

There has been considerable controversy respecting spontaneous ruptures of the cord. Most observers agree that it may snap if the woman is delivered while standing or sitting, so that the child's weight jerks and strains the cord. Pfannkuch's observations show that if a sudden jerk be given to a cord, a weight of 500–700 grammes will suffice to break it, but that 2,000–3,000 grammes may be gradually loaded upon it before it gives way. Spaeth has found a fresh cord sustain a weight of eleven pounds. The rupture of the liver, so often found when the cord has been intentionally torn, is caused by the forcible strain put on the child's abdomen during the process. Koch[1] reports the case of a IVpara, æt. 34, who was delivered of a child in the street; the cord was not divided and the amniotic sheath remained intact, but the continuity of the vessels was broken near both ends of the cord. On the third day there was hemorrhage about the navel, and the child died next day.

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[1] Cullingworth collected 32 cases. See Liverpool and Manchester Med. and Surg. Reports, 1876.

[2] Vierteljahrssch. f. ger. Med., 1873, i. 385; Med. Times and Gazette, 1854, i., 287.

Lamare[2] has gone thoroughly over the literature of this subject, tabulating and analyzing eighty-nine cases; he concludes that spontaneous rupture seldom occurs when the woman is lying down.

Cords vary greatly in resisting power: the living cord (warm, injected) is less resistant than the dead cord, and tears with a steady weight of 2,000–3,000 grammes, or 1,000–2,000 grammes if there is a fall or jerk. Short cords are not more liable to tear than moderate-sized ones, nor does thickness seem to have much effect. Spirals and vessel anomalies make weak points in the cord. A single application of force may tear the cord in several places. Contractions of the uterus and the abdominal muscles are occasionally sufficient to rupture the cord; so also may the movements of the child in or out of the uterus.

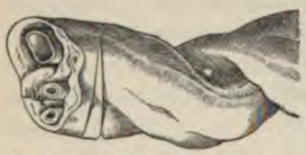
FIG. 31.—Umbilical Cord Cut with a Sharp Pair of Scissors, Showing Openings of the Vein and Two Arteries. A little lower down are two transverse superficial incisions with sharp edges. (Hofmann.)

The point of spontaneous rupture is oftener at the fœtal than the placental end. Hemorrhage from the ruptured and untied end is exceptional. When the mother is delivered in the standing position, and the cord ruptures, the child may receive fatal injury by falling on its head. Briand and Chaudé say that spontaneous ruptures occur only at either end of the cord, but not in the middle. Trachet denies this on the evidence of a case in which the cord tore spontanously in the middle.[1] Westphalen[2] has recently reported two remarkable cases of injury to the umbilical vessels during labor, in one of which the umbilical artery was ruptured before the discharge of the liquor amnii, and the child bled to death.

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[1] Archiv f. Gyn., xxix., 282.

[2] Thèse de Paris, 1888. "De la Ténacité et de la Rupture du Cordon umbilical."

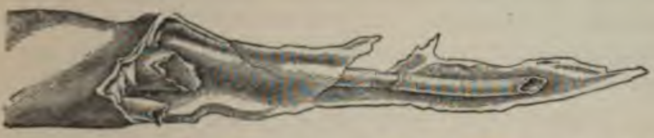

FIG. 32.—Umbilical Cord Torn Asunder during Precipitate Birth, while the Mother was Standing up and Dressing Herself. (Hofmann.)

Rupture of the cord may exceptionally occur when the woman is lying in bed in the usual position, and when traumatism and external manipulations can be excluded. Maygrier[3] reports five cases. Hamill[4] reports a case where death of the fœtus resulted from rupture of a large cyst of the umbilical vein.

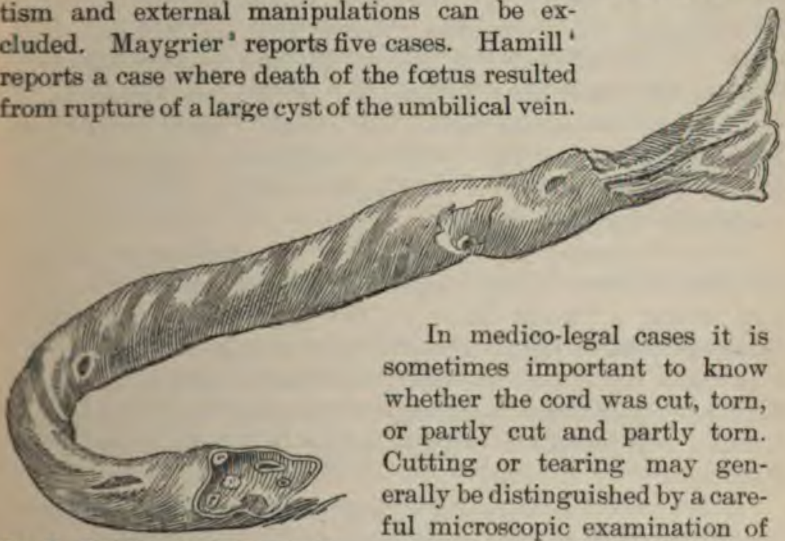

FIG. 33.—Umbilical Cord, Cut at One End, Torn at the Other. (Lesser.)

In medico-legal cases it is sometimes important to know whether the cord was cut, torn, or partly cut and partly torn. Cutting or tearing may generally be distinguished by a careful microscopic examination of the free end. If the cord is dry and hard, the end should be soaked in cold water for eight or ten hours, and then the examination can generally be made satisfactorily. In cases of doubt the cord should be preserved dry on a glass plate or clean white paper; it can be soaked and examined months afterward if necessary. Sections can be made and the relations of the arteries and vein and the degree of decomposition accurately determined.[1]

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[1] Archives de Tocologie, xv., 611.

[2] Archiv f. Gyn., 1894, xlv., 94.

[3] Progrès Médical, 1888, 2, 5; compare also Staes, Thèse de Lille, 1888, "Sur la Rupture spontanée du Cordon umbilical;" and Centralb. f. Gyn., 1889, 116.

[4] New York Med. Jour., 1888, 635.

It is doubtful whether any reliable case is recorded of a cord partially cut and partially torn. Such a condition might be possible if the mother tried to cut it with a dull knife, and impatient at the delay finally tore it asunder; or if she was delivered in the standing or sitting position, and the weight of the child tore through the partially severed cord. A curious case is reported by Koch.[2] A primipara, æt. 25, said that she was sitting in a privy when the child was suddenly expelled; it was dead when taken out of the privy. Question—Had the cord been cut with a knife or scissors, or torn by the weight of the child? There was a difference of opinion among the medical witnesses, but it was finally decided that the cord had been torn. It was interesting to note in this case that several other injuries had been done to the cord by the fall, a possibility which is not mentioned in the text-books. Winckel and Koch have since confirmed this by actual experience. Koch got five injuries in one cord by a jerk from a falling weight without completely tearing it through.

It is not always easy or possible to say whether a cord has been cut or torn. Gioia[3] reports a case where the cord was torn during a forceps delivery; the edges were smooth and indistinguishable from those of a cord cut with a knife. In such cases much depends upon whether the cutting was done with a sharp or blunt instrument; the jagged wound left by the ordinary dull household scissors might be hard to distinguish from a tear.

If the child dies from hemorrhage there is generally blanching of the body and an anæmic condition of the viscera. If wounds exist in other parts of the body, it is well to remember that fatal hemorrhage may have taken place from one of them and not from the cord. It is also possible to fall into error in attributing death to hemorrhage from the cord if the child has been dead for some time, for the anæmic appearance may be

[1] Friedreich's Blätter, xxxv., 391.

[2] Archiv f. Gyn., xxx.i, 282.

[3] Gazz. degli Ospedali, 1819, No. 65.

due to evaporation of the blood. Finally it is well to make sure that the cord was cut or torn shortly after birth, and not some time subsequently. Tidy[1] mentions a case where the body of a new-born child was taken from a river in which it had been floating for a fortnight, the placenta and cord remaining attached to the body. In removing it from the water the cord gave way and the placenta with part of the cord was carried away by the stream. A medical witness, seeing the ruptured cord and no marks of violence on the body, concluded that the cord had been torn by the woman at the birth of her child, and that it had died from hemorrhage.

Death of the Mother in the Act of Delivery.—How long may a child live in utero after its mother's death? This question has been very fully discussed by Dr. Harris[2] of Philadelphia, and a number of curious cases collected. Much depends upon the cause of the mother's death; if slow, as from hemorrhage, the chance of saving the child is small; if sudden, as from accident, the mother being in good health, the child may live an hour or two after its mother's death, but not longer. Gazerky[3] collected the reports of 379 Cæsarean sections after the mother's death; 37 children showed signs of life and 34 were delivered alive, 5 of whom lived. He refers to Breslau's experiments upon animals and the conclusions drawn therefrom, which are as follows:

1. The fœtus may undoubtedly survive the sudden death of the mother.
2. If extracted within six minutes of the mother's death, it may be reasonably expected to be born alive.
3. If extraction is delayed six to ten minutes, the child may be born alive, but will probably be asphyxiated.
4. If delayed ten to twenty-six minutes, it is certain to be deeply asphyxiated, even if born alive.
5. Frequently children are more or less asphyxiated or already dead in one minute after the mother's death.
6. The cause of the mother's death has an influence upon the length of time the child may survive.
7. The shorter the time between the application of the cause

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[1] Annales d'Hyg., 1873, ii., 443.

[2] Amer. Journ. of Med. Sciences, lxxviii., 389.

[3] Inaug. Diss., St. Petersburg, 1878; see Centralb. f. Gyn., 1879, 36.

of death and the stoppage of the heart, the longer will the child survive in utero; death by quick-acting poison is the most favorable for the survival of the child.

8. An immature fœtus survives as long as one at term.

9. Whatever may be the cause of the mother's death, the fœtus always dies of suffocation.

When mother and child both die shortly after the conclusion of labor it is sometimes important to know which survived the other. The medical witness may be asked for an opinion upon this point; but it may be difficult or impossible to arrive at a positive conclusion.

Prolapse of the Cord.—More than 50 per cent of the children are born dead, the circulation being arrested by the pressure upon the cord during the process of birth. Death is from asphyxia. Scanzoni collected 743 cases of prolapsed cord, and in 408 the child was born dead, nearly 55 per cent. Kleinwächter[1] makes the proportion 56.52 per cent.

Traction upon an abnormally short cord or one shortened by being coiled about the child's neck or body may cause death in a similar way and be therefore unavoidable. Hohl found 18 fatal cases out of 181; Mayer reports 18 fatal cases out of 685 in Nägele's clinic.[2] Sclafer had a case in which the cord was only 10 mm. long, and Stute[3] reports one where the cord was entirely wanting. The tightening of the coils about the neck may leave marks similar to those caused by soft ligatures applied for criminal purposes; they are broad and never excoriated, and not to be confounded with markings from folds of the skin or ridges in the fat of the neck, especially in winter.[4]

Davis[5] reports a case where the child was born alive and heard to cry, but was subsequently strangled accidentally by the mother, who moved her body away from the child to keep from injuring it. The cord happened to be coiled around the child's neck, and the mother's movement tightened it and strangled the child. In cases where such a plea is set up in defence, the neck should be carefully examined for marks of constriction and the length of the cord ascertained if possible.

Loops or knots of the cord may be tightened either by the child's movements before labor begins or by the expulsive efforts of labor; in the latter event there may be marks of strangulation post mortem although the child was not born alive.

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[1] Prag. Viertelj., 1870, iii., 84.

[2] Hofmann: "Lehrb. d. ger. Med.," 1891, 766.

[3] Monats. f. Geb., 1856, vii., 1.

[4] Vierteljahrssch. f. ger. Med., 1873, ii., 219, 224.

[5] Brit. Med. Journ., 1882, ii., 1069.

Spasmodic contraction of the uterus around the neck or body of the child may produce suffocation; a similar result may follow compression of the cord in breech, version, or forceps cases, in cases where there is delay or great difficulty in delivery,[1] or where the membranes envelop the face and mechanically prevent respiration.

In any of these cases, premature efforts to breathe may be excited,[2] and mucus, blood, liquor amnii, or meconium aspirated into the respiratory passages just as water is aspirated in death by drowning. The foreign bodies may be recognized with the naked eye, but it is always well to use a lens. A microscopic examination often reveals the presence of epithelial scales, fat globules or crystals, woolly hairs, etc. Ecchymoses are often found in the heart and lungs. It may be said that similar appearances would be present if the child was suffocated after birth by aspirating similar matters; but then air would be drawn into the lungs and the signs of live-birth would be present. The history of the case, the testimony of the professional attendant who would probably be summoned in case of difficulty or danger, and the unmistakable marks of injury or violence, should make the diagnosis of such cases easy. The mortality is much greater in concealed cases, on account of the absence of skilled assistance.

VIOLENT CAUSES OF DEATH.

In most cases of infanticide there are marks of external violence such as wounds, bruises, fractures, burns, marks of strangulation, etc. These will indicate the way in which the post-mortem should be conducted to ascertain whether there are internal injuries corresponding with the external. Sometimes there can be no doubt of the wilfulness of the violence—it is too extensive and severe to have been accidental; at other times it may be impossible for the medical evidence to distinguish between wilful and accidental.

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[1] The head may be so compressed during a difficult labor where there is disproportion between the head and the passage through which it must be forced, that the brain is injured or effusion of blood may take place, which proves fatal either immediately or in a few days.

[2] For numerous references to the literature of death from premature efforts at respiration, see Hofmann's "Lehrb. der ger. Med.," 767, note at foot of page.

In order to secure conviction, the prosecution must clearly prove that fatal violence was purposely inflicted upon a child which was legally alive. The child may die subsequently from the effect of injuries inflicted at the time of birth; upon the presence or absence of intent hinges the legal distinction between murder and manslaughter in its different degrees. The medical witness has nothing to do with such distinctions except in so far as the site or degree of violence bears upon the wilfulness or otherwise with which the injury was inflicted.

A question of professional responsibility sometimes arises in this connection. Medical men have been accused of culpable ignorance or carelessness, or malpraxis, when the death of mother or child has followed some operative interference. In a case of difficult forceps delivery one of the cranial bones was fractured and the child died immediately after its birth; the attendant was tried and convicted of manslaughter. It will probably be alleged in prosecutions of this kind that unnecessary violence was used and that the injuries inflicted were due to the ignorance or unskilfulness of the attendant, or that the case was manifestly unsuitable for instrumental interference, and the operation should not have been performed. Proof of gross ignorance and incompetence would be necessary for conviction. It is very difficult to decide from a post-mortem examination that an operation was unskilfully performed or that the operator was ignorant and incompetent. It is also much easier to tell, after an operation is over, whether or not it was the best which could have been done under the particular circumstances. Positive opinions should therefore be given with great caution. Physicians should protect themselves against subsequent annoyance when called to a difficult operative case which has been under the charge of others. It is always well to ascertain whether any injuries already exist in the genital tract before undertaking further operative measures.

Neglect or Omission.—A child may be born alive and die from neglect to tie the cord properly; it may be suffocated by the bed-clothes or the blood and discharges of the mother, or by pressure of her thighs. When the mother is suddenly seized with labor pains, and the child is born while she is standing or sitting over a closet or privy, the child may drop upon the floor and fracture its skull, or may drop into the closet or privy and suffocate before help comes.

Such an accident is very unlikely to happen in a woman's first confinement, and is therefore not very likely to be admitted as a satisfactory defence in the case of a primipara. The law presumes that a married woman or one who has borne children should know what ought to be done for a new-born child; yet she may be incompetent to attend to the child herself at the time of her confinement, having been overcome by pain, faintness, hemorrhage, or excitement. She should make her condition known when she feels labor pains coming on, and should seek help when about to be confined. The defence which is usually advanced is that she was surprised by the sudden and violent onset of labor, and so overcome by faintness that she could not attend to the child. Such a plea would not hold good unless she could prove that labor was really precipitate or that she had tried to get help but could not, or that the child was born before assistance arrived. The mother has been severely punished for concealment and culpable neglect,[1] but conviction is always difficult, since there must be positive proof from her own admission or from medical evidence that the child was born alive.

With regard to negligence, the law generally holds that if a woman has failed to take ordinary precaution to save her child, she is guilty of criminal negligence.—"*Qui tacet, consentire videtur.*"

The possibility of a woman's fainting and losing consciousness during the birth of her child is now abundantly proved. It is more apt to occur when an attempt is being made to conceal the birth, than when labor is going along in the ordinary way. There is no positive sign by which we can judge afterward whether a woman has fainted during delivery or not; we can only judge of the truthfulness of her story by a careful examination of all the circumstances.[2]

Suffocation is the commonest form of violence because it is the easiest. Tardieu says that out of 132 new-born children which he examined, in 72 there was clear evidence of death by suffocation. The mouth and nose may be obstructed by the body or clothing of the mother, or foreign substances which prevent the entrance of air to the lungs. The child may be placed face downward on a soft pillow or feather-bed and allowed to suffocate, or a pillow may be held over its face. Respiration may be prevented by keeping the mouth and nostrils forcibly closed, or it may be arrested if it has been established. Or the child may be received in water or other fluid, or it may be born in a closet or privy vault and its mouth and trachea be choked with fecal matter, water, ashes, or dirt. Feathers, wool, mud, clay, sponge, handkerchiefs, hay, and other such substances have been forced into the new-born child's mouth to suffocate it; or it may be prematurely buried, or its body forced into a small box or trunk.[1] An infant of five months died suddenly in Haute-Savoie. Eight dark gray bodies were found in the stomach, which proved to be pieces of sponge given to the child with criminal intent.[2] (See cases 17, 18, 19, 20.)

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[1] Taylor's "Med. Jurisp.," Am. ed., 1892, p. 569.

[2] For a full review of this subject, see Freyer's "Ohnmacht bei der Geburt," Berlin, 1887. A large number of cases are analyzed and tabulated in the appendix.

The real difficulty in many of these cases is to determine whether death was accidental or not. A careful examination should be made of the mouth and air-passages both inside and out, to ascertain whether violence had been employed, and whether the foreign matters had been forcibly introduced or accidentally aspirated. There should be no marks of violence, or at least not such as would indicate attempts upon the child's life, if the plea of accident is to be accepted.[3] A living child was born precipitately while the mother was sitting over a bucket of water; the mother fainted and the child suffocated. Under the circumstances the death was undoubtedly accidental.[4] Leblond[5] reported a remarkable case of unconscious delivery to the Medico-Legal Society of Paris. A woman, aged twenty-seven, who had been seduced and deserted, was seized with slight colicky pains, but continued to work. Next night she had still sharper pains. Thinking that a motion would help her, she sat down upon a night-stool, and presently a living child was born. Though much alarmed, she managed to cut the cord, and, wrapping the child in a cloth, she carried it downstairs and told the people in the house what had happened. The cord was not tied. Next morning Leblond saw the patient and found the placenta still in the vagina. Mother and child did well. Had the child died the mother would probably have been suspected of intentionally neglecting her child, especially if she had gone to an outside privy.

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[1] For a full report of three cases in which suffocation was effected by means of a feather-bed, the mother's hand, and wrapping in an apron, see Vierteljahrssch., 1891, i., 19.

[2] Répertoire de Pharmacie, January 10th, 1893.

[3] Vierteljahrssch. f. ger. Med., 1874, ii., 123.

[4] Friedreich's Blätter f. ger. Med., xxxvi., 64.

[5] Journal de Méd. de Paris, July 30th, 1893.

A similar case was admitted a short time ago into the Montreal Maternity. The mother, a servant-girl, continued her work till an urgent desire to defecate compelled her to go to the closet; in a few minutes a living child was born in the closet, but was rescued without suffering any damage. She was unaware that she was about giving birth to a child. In another similar case the child was born into an old-fashioned pan-closet; the mother pulled up the lever and tried to force it down into the soil-pipe. It was too large to pass down, but when it was examined subsequently, its appearance proved that it had died in utero some time previously. Pullman[1] relates a case where there was no motive for concealment, in fact a child was earnestly desired. It was born unexpectedly, and was saved only by the timely appearance of the midwife.

Brouardel[2] says that the most important point in judging of such cases, is the position of the mother during delivery. He says a woman cannot bear a child in the upright position; if seized with labor when sitting on a closet, the child cannot be born into the closet, but must come out upon the front border of the seat. He also states that a full-term child cannot pass through an ordinary house-closet, because the diameter of the largest closet outlet is 12 cm., while the transverse diameter of a child at the shoulders is 18.2 cm.

While painless labor is not common in primiparæ, it may nevertheless occur. Brunon[3] reports such a case, where the child would have been born in a closet had the mother not got away just in time. It is therefore needful for the medical witness to weigh well all the facts of the case before deciding that the suffocation could not have been accidental, remembering that the finding of a child suffocated in a closet is not necessarily a proof that it was intentionally destroyed. In England it is very common for nursing infants to be suffocated at night while sleeping on the mother's breast, or by the mother rolling over upon them. The mother, exhausted by her day's work and sometimes more or less under the influence of liquor, sleeps heavily, unmindful of the child at her breast; in the morning she wakes up and finds her infant stiff and cold. In Liverpool on an average three inquests a week are held upon suffocated infants,[1] three-fourths of them being over one month and under one year old.

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[1] Vierteljahrssch. f. ger. Med., April, 1891, i., 276.

[2] Gaz. des Hôpitaux, 1888, p. 109.

[3] Normandie Médicale, 1890.

The mother sometimes suffocates her child by putting her finger in its mouth to stop its crying. Hofmann and Liman mention three cases each, Schiller[2] one, and Wendel[3] three. In the first of Wendel's cases, immediately after birth the mother struck the child upon the head with some hard substance, then thrust the index finger of her left hand into its mouth and held it in the pharynx till the child died. She did this not so much to destroy the child as to prevent it from crying and betraying her secret. The throat has been plugged with straw for a similar purpose. In such cases marks of violence will be found about the mouth, tongue, and pharynx.

The post-mortem appearances of suffocation in new-born infants are similar to those observed in adults, provided respiration has been established. The most constant condition is engorgement of the internal organs (especially in the thorax). Subpleural and subpericardial ecchymoses occur in eighty per cent of the cases. Brouardel[4] says that these signs are commonly found in other conditions and are not by themselves a proof of violent suffocation. Some rely upon the bloodless condition of the spleen. Fritsch assigns but little forensic value to these ecchymoses, since they may be absent in undoubted cases of suffocation, and present even in the macerated fœtus. In eighteen autopsies on macerated infants performed in the Marburg Clinic, Klein found extravasations in seven, mostly under the pleura and pericardium. One of these cases was of particular interest. In a child born spontaneously, with commencing maceration, ecchymoses were found on the thoracic viscera, mucus with lanugo hairs in the trachea, and a subaponeurotic hemorrhage the whole length of the sagittal suture. Had the child been born before the commencement of maceration, and its body concealed, perhaps these post-mortem appearances might have justified an opinion of death from violence.

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[1] Brit. Med. Jour., Jan., 1885, 186.

[2] Vierteljahrssch. f. ger. Med., xlvii., p. 297.

[3] Inaug. Dissert., p. 35.

[4] Gazette des Hôpitaux, 1880, p. 101.

Drowning may be accidental or intentional. It cannot be proved by medical evidence that death was caused by drowning unless respiration has been established. If the woman was delivered in a bath and the child was born under water and kept there till life was extinct, there would be no evidence post mortem of drowning. After respiration has been established, the appearances would be similar to those found in older children or adults.

When the body of a new-born infant is found in the water, it is important to determine whether the child was living or dead when put into the water, and whether death was caused by submersion or not.

It very commonly happens that an infant is destroyed in some other way, as by strangulation or suffocation, and is then thrown into the water to conceal the mode of death. It therefore does not follow that a child died by drowning, because its dead body was found in the water. In such cases a careful examination should be made for marks of violence, special attention being directed to the condition of the ears, nose, throat, respiratory passages, and stomach. A very small quantity of fluid may drown a child; enough water, liquor amnii, blood, etc., to cover the mouth and nose will suffice; complete submersion is not necessary. (See case 15.) The defence may plead that the child was dead-born and was thown into the water to conceal its birth; the medical witness will be called upon to say whether it was really dead-born, or had been born alive and breathed; in the latter case whether it was alive or dead when thrown into the water, and whether the submersion was the cause of death. Or the accused may admit that the child was born alive and breathed for a time, but may assert that it died from natural causes and was then thrown into the water for the purpose of concealment. The medical witness may be required to say whether death was from natural causes; if not, whether drowning was the cause.

If the water in which the body was found is some distance from the place where the child was born, it may be asked whether the mother was able or likely to have carried it such a distance so soon after being delivered. Women are sometimes capable of almost incredible exertion when trying to conceal the birth of an illegitimate child, therefore the medical witness should be careful how he denies the possibility of such exertion. Alison mentions the case of a woman two or three days confined, who walked twenty-eight miles in a day with a child on her back. It is not at all uncommon for women to walk several miles or do a hard day's work immediately after being confined.

If the child has been found drowned in a water-closet or night-stool or privy-vault, it may be claimed by the accused that labor came on unexpectedly, that she could not rise or secure assistance, and that the child dropped from her body, and was drowned in spite of all she could do. This story may be true or false, and the medical witness may be able to corroborate her statements, or show that they are not borne out by the post-mortem appearances. The cord may be found cut, not torn, or there may be marks of external violence disproving the story of unexpected, precipitate labor and accidental drowning of the child. (See case 21.)

Cold and exposure may readily destroy the life of a new-born child. There may be no marks of violence observable, and no post-mortem appearances to indicate the cause of death, except perhaps cerebral congestion. The evidence may be mostly circumstantial, and the medical witness may have no other grounds upon which to base his opinion than the place where the body was found, the season of the year, the temperature of the air, the length and kind of exposure, etc. To constitute murder, wilful malice must be proved; this is very hard to do, and convictions are rare.

Starvation is still harder to prove; it is often a factor in death by exposure. It may be necessary to test the stomach and intestine for the presence of food. Medical evidence is usually of slight value, and the case depends chiefly upon circumstantial evidence. If the child is immature or feeble, it is less able to take or digest food, and death is more likely to have occurred from natural causes.

Wounds may be the cause of death, or may be found on the body when death was due to other causes; they may have been produced accidentally or with criminal intent; they may have been inflicted during life or after death. The medical witness may have to determine whether they were sufficient to cause death, whether they were actually the cause of death, and whether they were accidental or homicidal.

Wounds in children present similar appearances to those in adults. In addition to the ordinary incised, lacerated, and contused wounds, there may be minute punctures and incisions cunningly contrived to cause fatal damage with very little external signs of their presence. The brain has been pierced by needles thrust through the fontanelles, the nose, and the orbit. Stannus[1] refers to punctures of the brain through the upper eyelid, and Dr. Handsel Griffiths[2] finds from experiments upon animals that fatal injury may be easily inflicted in this way, and is difficult to detect (Tidy). Taylor says that the spinal marrow has been wounded by needles or stilettoes introduced between the vertebræ, the skin having been drawn down before the wound was inflicted to give it a valvular and apparently superficial character. Incised wounds may be attributed by the defence to broken utensils, surgical instruments, or the accidental slipping of knife or scissors while cutting the cord. In that event the wounds are not likely to be multiple or extensive or accompanied with much violence, and the cord would be found cut, not torn.

If the body has been found dismembered or cut up, the accused may allege that it was born dead, and the mutilation was done to conceal the birth. The tests for live-birth would show the truth or falsity of such a plea.

Injuries to the Head.—The caput succedaneum and cephalæmatomata have been occasionally mistaken for bruising and swelling caused by violence. The caput succedaneum is an œdematous swelling on the presenting part, involving the skin and subcutaneous tissues but not the periosteum and bone; when incised, a serous or serosanguineous fluid exudes. A cephalæmatoma is an effusion of blood beneath the periosteum. These tumors are the result of pressure moulding the head so that it may be able to pass through the parturient canal. The smaller the head and the larger the pelvis, the less the liability to these swellings. Cephalæmatomata do not usually appear till the second or third day. If the labor has been difficult and prolonged there may be small ecchymoses of the scalp or pericranium, but no injury to the bones or scalp, and no signs of external violence; whereas in swellings caused by violence there will be more or less injury of the surface, effusion of blood, and perhaps fracture of the bone. (See case 14.)

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[1] Irish Med. Gaz., August 15th, 1873. [2] Lancet, October 11th, 1873, 519.

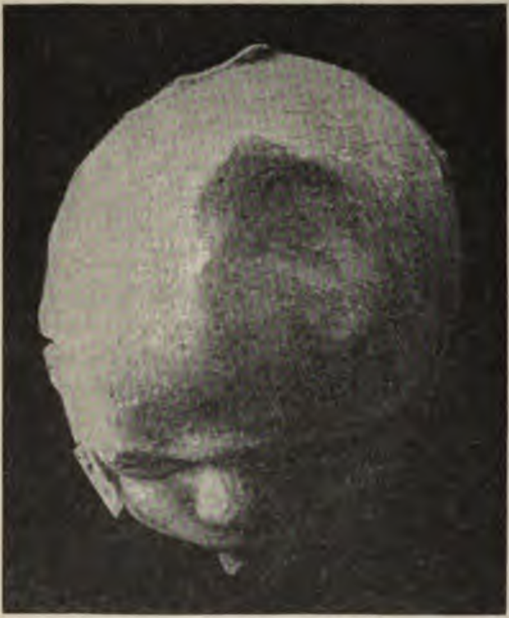

FIG. 34.—Spoon-shaped Depressed Fracture of Left Frontal Bone, the Result of Violent Uterine Action. (From Specimen in Museum of McGill University.)

The head will stand a certain amount of compression during labor without endangering the child's life, but if the limits be exceeded there may be intermeningeal extravasation, rupture of the sinuses, compression of the brain, or premature attempts at respiration. If disproportion exists between the head and the pelvic canal, especially if there be abnormal projection of the sacral promontory, the uterine efforts may cause a spoon-shaped depression upon the frontal or parietal bone.[1] It is quite possible, however, for such a depression to be caused by wilful violence after birth.[2] Bruises and wounds may be caused by the pressure of a forceps blade during instrumental delivery.

It will thus be seen that fractures, furrows, and indentations of the cranial bones may occur during instrumental delivery in contracted or deformed pelves, either from pressure of the forceps blades or the abnormal projection of some part of the pelvis, most frequently the sacral promontory.

[1] Vierteljahrssch. f. ger. Med., xxx., 260.

[2] Wien. Med. Presse, 1885, Nos. 18–28.

In European countries, where pelvic deformity is common, such accidents are not infrequent; and even when labor has been completed by the natural efforts, furrows and depressions are occasionally found. Though it is well known that intrauterine fractures of long bones may be caused by violent uterine action, it does not seem to be generally recognized (in this country at least) that fractures of the cranial bones may be produced by unaided uterine contraction. Only under exceptional circumstances could such an accident happen, yet in a medico-legal examination the possibility should be borne in mind. The following case, which came under my own observation in the Rotunda Hospital, Dublin, was reported to the Obstetrical Society of that city by Dr. W. J. Smyly, then assistant master (now master) of the Rotunda.[1]

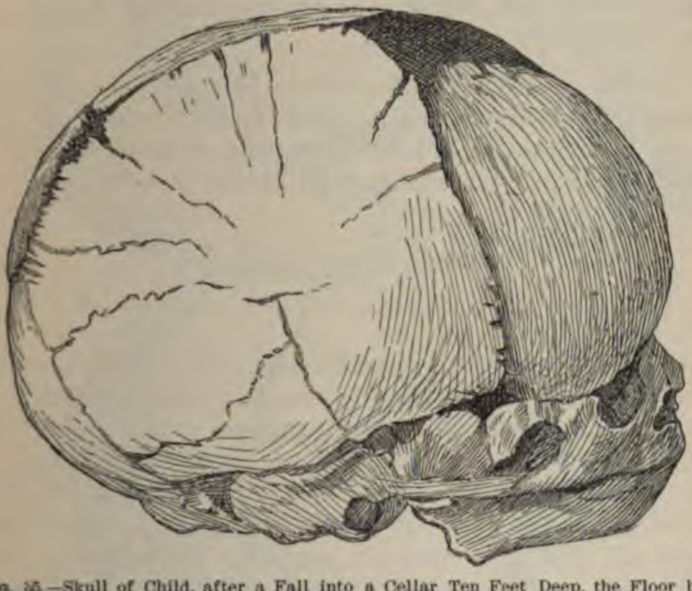

FIG. 35.—Skull of Child, after a Fall into a Cellar Ten Feet Deep, the Floor being Stone. The right parietal region struck first, the parietal protuberance was flattened and fissures radiated from the flattened area. (Lesser.)

In a healthy, strongly built woman, VIIpara, labor began about the end of the eighth month of pregnancy; head presenting, cord prolapsed and pulseless. Although pains continued strong and frequent, the head

[1] Obstet. Journal of Great Britain and Ireland, vi., 328.

did not come down, but was found to be still above the brim eleven hours after rupture of the membranes. Then suddenly while a vaginal examination was being made, a violent uterine contraction drove it through the brim with a jerk, and labor terminated almost immediately. There was some difficulty in extracting the shoulders. The child had not been very long dead; there was no caput, no attempt at moulding, but a spoon-shaped depressed fracture of the left frontal bone. As the biparietal diameter could not pass the narrowed conjugate, the head could not engage in the brim or descend into the pelvis. It lay above the brim displaced to the left, with the forehead jammed against the projecting promontory; a sudden violent pain fractured and depressed the frontal bone, and labor terminated precipitately. This fracture could not have been distinguished post mortem from one produced after birth by direct violence.

It is even possible for the skull to be fractured by the compression it undergoes while being forced through a tough cervix.[1] In these exceptional cases there would be a history of difficult labor and the existence of disease or deformity in the pelvis. The ease of fracture depends on the extent of ossification; the greater the ossification, the easier the fracture.

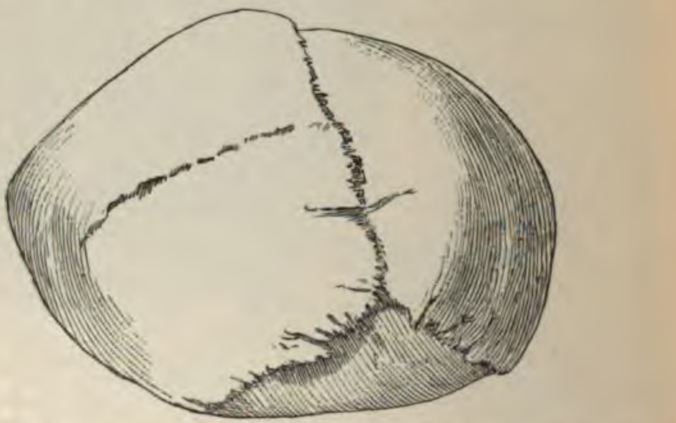

FIG. 36.—Fissure on Left Parietal Bone, Produced by Mother's being Delivered Standing on the Street, While on her Way to the Hospital. (Lesser.)

As a rule these accidental fractures are slight, rather in the form of fissures beginning at a suture or fontanelle and extending an inch or so into the substance of the bone. The frontal, temporal, and parietal bones are most likely to be fractured or fissured; in the majority of cases, it is the parietal.

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[1] Edin. Med. and Surg. Journ., xxvi., 75.

Such injuries are usually slight and unaccompanied by ecchymoses and severe bruising or wounding of the scalp. But occasionally ecchymoses are found either outside or beneath the pericranium even after easy labors, generally in the vicinity of the sutures. They are caused by tearing of the vessels from the violence of the expulsive efforts.

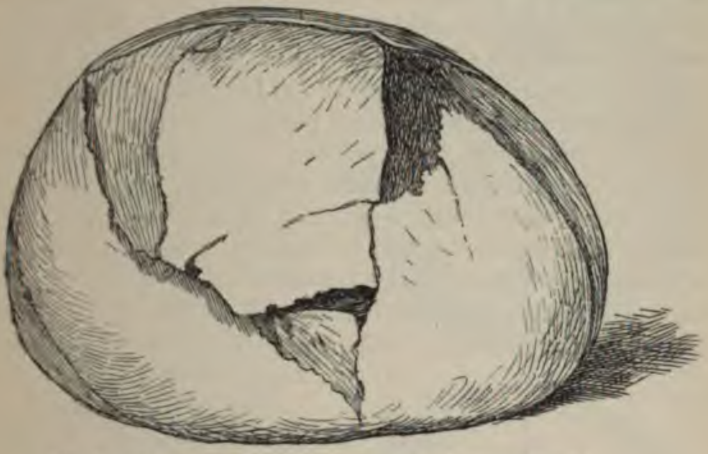

FIG. 38.—Fracture of Skull by Intentional Violence. (Lesser.)

Their forensic value depends upon the proof of live-birth. There would be no injury to the scalp or cranial bones, if they were produced by natural efforts while the child was still in utero. In fractures the result of criminal violence, the skin is generally lacerated and bruised, and in addition the cranial bones may be driven in, wounding the brain substance, or clots of blood may produce compression. The method of distinguishing between fractures during life and after death are practically the same for infants as for adults.

Care must be taken not to confound defects in ossification with fractures or the effects of criminal violence[1] (Fig. 39). Cranial bones may be fractured during difficult forceps-operations, especially over the orbital arches; the mark of the blade is easily made out, and should prevent error in diagnosis.

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[1] Prag. Vierteljahrssch., cxxiii., 53; Schmidt's Jahrb., 1851, lxix., 224.

Fractures or fissures may occur in the same situation in cases terminated by natural efforts if the bones are thin and fragile.

Fractures of the skull are not necessarily fatal, whether occurring before or after birth. Henoch[1] reports two cases of holes in the skulls of infants under six months of age, which he attributes to fracture at the time of birth. He thinks that fissure is the first stage of the hole, absorption of the bone-salts occurring on each side of the line of fracture till a large aperture is formed. Cerebro-spinal fluid is apt to escape through a vent in the adherent dura and pia mater, and local inflammatory action finally destroys life. One case was over five months, the other about three months old. In the first there was a tense elastic tumor the size of a kidney over the right ear; it could be diminished by pressure, always increased when the child cried, and the light could be seen through it. When tapped, a clear albuminous fluid was obtained. In the second case a similar tumor lay to the right of the sagittal suture. The head may be severely injured in utero and be more or less completely repaired. Wendel[2] reports a case where the tabular portion of the occipital bone was fractured in utero; the process of repair was well advanced when the child was born. Priestley[3] reports a curious case in which there was found at birth a circular wound the size of a shilling situated over the posterior fontanelle, looking as if it had been punched out; the process of repair had begun. The mother was a multipara and the labor was easy. (Fig. 6, Pl. IV.)

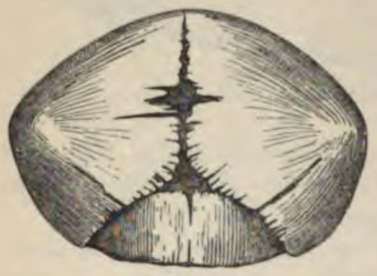

FIG. 38.—Fœtal Skull, Showing Accessory Fontanelle and Congenital Fissures in the Posterior Third of the Sagittal Suture; also Symmetrical Congenital Fissures in Lambdoid Sutures of Both Parietal Bones. Might be easily mistaken for results of mechanical violence. (Hofmann.)

Intra-uterine injuries may be sustained by the fœtus, without any recognizable marks being left on the mother's abdomen. Heavy blows on the abdomen with blunt instruments, or falls from a height, may injure or kill the child without seriously affecting the mother. Hofmann[1] mentions the case of a woman who was thrown down from a four-story window; the abdominal wall and uterus were uninjured, but the placenta was partially separated, the membranes torn, the right lobe of the liver ruptured and a quantity of blood effused into the abdominal cavity. In another case, there was a wound of the skin behind the left ear, an ecchymoses under the right breast and left thigh, and a transverse tear of the peritoneum over the right lobe of the liver. Charcot observed rupture of the spleen from a fall of the mother. Dietrich describes the case of a woman in the thirty-sixth week of pregnancy, who fell down a steep stair, and sixteen days afterward bore a child with a wound on both frontal protuberances; the edges were cicatrizing. In 1872 Tarnier[2] showed the Paris Surgical Society a day-old child with a cicatrix on the crown of the head, probably caused by an attempt to produce abortion by mechanical measures. Gurlt mentions two cases: in one a pregnant woman and her fœtus were wounded with a scythe, and in the other with a pitchfork; the children died, but the mothers recovered.

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[1] Brit. Med. Journal, 1889, i., 32.

[2] Inaug. Dissert., p. 56.

[3] Trans. Lond. Obstet. Soc., 1860, i., 60.

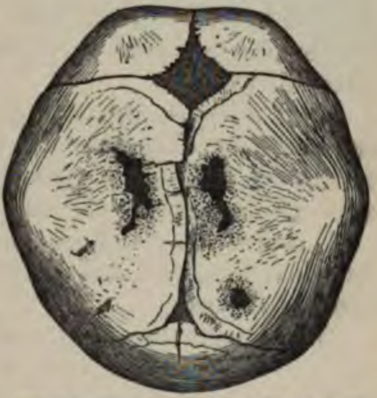

FIG. 39.—Ossification Defects in the Parietal Bones of a New-born Child. Might easily be mistaken for marks of violence. (Hofmann.)

Intra-uterine injuries most frequently affect the long bones, very rarely the cranial bones; in some of the reported cases the formation of callus was observed. Tidy says that a mare in foal fell into a quarry; her colt was subsequently born dead with a fractured skull. A costermonger kicked his donkey, which was near her foaling time; the young donkey when born had fracture of the foreleg and skull.

When the head of a new-born child is found to have been severely bruised or fractured the plea is sometimes advanced that the mother was suddenly taken with labor pains and the child was born while she was sitting, standing, or kneeling, and that the injuries found upon the child's head were due to the fall. It is quite possible for such an accident to happen,[1] and bruising may occur, but fracture is not common. If it does occur, it will most likely be in the form of fissure unless the fall has been great. (See cases 8, 11.) Multiple fractures and extensive marks of violence would tend to negative the theory of accident.

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[1] Hofmann: "Lehrb. f. ger. Med.," 1891, 761.

[2] Union Médicale, 1872, No. 33.

A child born in the way indicated may live for several days and finally die of convulsions, and the autopsy may reveal fracture of the skull and compression of the brain by a blood-clot, although no signs of external violence may be present.

It is obvious, therefore, that each case must be decided upon its own merits, and that no rules can be formulated which will apply to all cases.

Occasionally the child may be destroyed by dislocation of the cervical vertebræ and injury to the cord produced by extreme or forcible rotation. This may happen in forceps cases, especially while attempts are being made to correct malpositions, or in breech cases in the extraction of the head. Such injuries are generally accidental and are easily recognized by the post-mortem examination.

Occasionally a new-born child may be put into the fire and burned, and the question may arise as to whether it was alive or dead when the burning took place. If the body is so charred that evidence of live-birth cannot be obtained, the medical evidence will not be able to decide.

When marks of violence are found upon the head or body of the child, which cannot be explained by violent uterine action or accidental fall, the usual defence is that they were accidentally inflicted while the mother was struggling to complete her own delivery. The law humanely recognizes the possibility of a woman's being frenzied by pain while the child is passing through the vulva, and rendered unaccountable for her actions. She may be deprived of judgment and may destroy or injure her child. A case came under my observation where a woman seized her child as it was passing through the vulva, dragged it forcibly out and flung it through an open window.

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[1] Med. Times and Gazette, 1860, ii. 219; Lancet, 1861, i. 13; Amer. Journ. Med. Sciences, 1861, 279.

It is quite possible for a woman to injure her child severely while trying to hasten her delivery. She may seize the head or neck with both hands, scratch and bruise the face and neck with her nails and fingers; there may be finger-marks upon the neck, extravasations of blood in the sterno-cleido-mastoids, dislocation of the cervical vertebræ, but not fracture of the skull. The shape, direction, and situation of the marks distinguish them from other kinds of violence.

Marks of violence inflicted by the mother are not sufficient in the eye of the law to prove infanticide; there must be evidence to show that the violence was committed knowingly and intentionally.

Strangulation.—It is not always possible for the medical evidence to decide whether strangulation has been accidental or criminal. The defence usually claims that death was accidental, having been due to the coiling of the cord about the child's neck or body. In such cases the twisting of the cord generally takes place in utero, and death is caused by pressure on the cord and arrest of the fœtal circulation, not by strangulation at all. Consequently in the majority of such cases the child dies before birth, before it has breathed, and the lungs are found to be in the fœtal state. But when the coils have really prevented the access of air to the lungs by constricting the neck, and the child has strangled, the probability is that the cord was twisted around the neck after birth and the child purposely destroyed. (See cases 1, 2.)

It may, therefore, be said that as a rule death has been accidental when the lungs are in the fœtal state, homicidal when they have been expanded.

Much stress has been laid upon the appearance of marks of the cord on the neck; these are broad, shiny, depressed streaks, sometimes livid and discolored, which encircle the neck; when incised, they show signs of ecchymosis. Not much reliance can be placed upon these marks for medico-legal purposes; they may be found in accidental cases and may be absent in homicidal cases where undoubtedly much violence has been used. If a ligature or cord has been twisted tightly about the neck during life, in all likelihood there will be swelling and œdema of the tissues above and below the constriction. (See case 12.)

Neither depression, lividity, nor ecchymoses (if slight) can be depended upon to distinguish positively between accidental and criminal strangulation. However, in criminal cases more violence is used than necessary, and the mark of the cord is apt to be deeper, broader, and more ecchymosed; there may be also extravasation of blood, abrasions and lacerations of the skin, and injuries to the windpipe and muscles of the neck. In accidental cases there is no injury to the skin and underlying parts, and the lividity and ecchymoses are slight and partial. It is entirely a question of degree, but it is improbable that the cord could be accidentally tightened during birth so as to produce marks resembling those resulting from criminal violence, while at the same time the child is able to breathe sufficiently to expand its lungs fully with air.

The post-mortem examination of the lungs is therefore of the utmost importance in such cases. It may be alleged by the defence that the head was delivered but that the cord was too short to permit any further advance, and that the child breathed but perished before it could be completely delivered.

Even severe compression is not necessarily fatal, for occasionally children are born alive with marked depressions on the neck from pressure of the cord.

It is not possible to determine, from external appearances only, whether the constriction was applied to the neck during life or shortly after death. Casper holds that if applied within an hour, the marks cannot be distinguished from those made on a living body. It is also impossible for the medical witness to say whether the compression was effected before or after the child was completely born, before or after the cord was divided.

Division of the cord has no legal significance; a child may be legally born though its cord is not divided; or again its cord may be divided and yet the child may not be legally born.

Not all livid marks upon the neck have been caused by pressure of the cord. Depressed marks are often produced in the front of the neck by forcibly flexing the head on the chest, especially if the neck is fat and the weather warm. These appearances may be produced equally well upon the dead body, if it is still warm.

It has been claimed that the os uteri may constrict the neck with sufficient force to produce a livid streak. I have often seen on the necks of still-born children marks which were not distinguishable from those produced by the compression of the cord. Finger-marks and nævi have sometimes been mistaken for marks of the cord.

It is evident therefore that external appearances have only a relative value in determining whether death was due to strangulation or not, whether the constriction was accidental or wilful, and whether it was applied before, during, or after birth, before or after death. Yet a minute examination should be made of the external appearances in all cases, for occasionally valuable evidence is obtained therefrom. More reliance, however, is to be placed upon the examination of the lungs.

Hanging is rarely the cause of death in new-born infants. The signs are the same as in adults. (See Vol. I., pp. 735 *et seq.*)

Poisoning is also a rare cause of death. Opium in the form of soothing-syrup is probably the commonest poison. When the mother is addicted to morphia, her nursing infant is sometimes poisoned through her milk. Several cases of fatal morphia poisoning in this way have been reported. Hofmann mentions a case where a young woman poisoned her two-days-old child with nux vomica. Arsenic and phosphorus have occasionally been administered. (See case 33.) Caustics have been introduced into the mouth on sponges or cloths. Even if poison is detected, it is always difficult to trace the crime and fasten the guilt upon the administrator with sufficient certainty to secure conviction.

METHOD OF PERFORMING A POST-MORTEM EXAMINATION UPON A NEW-BORN CHILD FOR MEDICO-LEGAL PURPOSES.

The post-mortem examination is a very important matter in cases of infanticide which come to trial. No physician should attempt to make such an examination, unless he has made himself familiar with the correct and approved methods. Unless he follows the proper sequence, he will be unable to obtain all the information that is possible or necessary, and it will then be impossible to repair his mistake. The technique differs somewhat from that of an ordinary post-mortem. The external examination should be more minute, and the internal examination should be made so as to determine the actual cause of death, and exclude all others which might be suggested. Full directions are given in Chartier's monograph,[1] Vibert's[2] medical jurisprudence, etc. Some useful hints may also be found in a recent lecture by Dr. Cattell,[3] of Philadelphia; his method of evisceration is specially worthy of notice.

The following taken from Vibert's handbook gives concisely the proper order and the principal points:

1. Note the sex.

2. Determine the length. Extend completely the lower limbs, place a rod vertically and as a tangent to the vertex, measure with a rigid rule the distance between this rod and the soles of the feet.

3. Determine the weight; if the placenta is still attached to the body, separate it and weigh it separately.

4. Measure the antero-posterior and biparietal diameters of the head.

5. State of the umbilical cord; soft or dry; length, if evenly divided torn or broken, if it is ligatured; if there are signs of commencing separation at its base.

6. Note putrefaction; its degree.

7. Condition of the surface of the body; if soiled with blood, meconium, or foreign matters. Presence and position of vernix.

8. Congestion of face; ecchymoses of conjunctivæ.

9. Marks of violence on body, describe them minutely. Make on the face and anterior part of the neck a number of incisions close together, through the cellular-adipose tissue, to determine whether there are any subcutaneous ecchymoses.

10. Incise the sides of the mouth following the labial commissures; see if there are foreign bodies in the cavities of the mouth and pharynx, or traces of violence on the tongue, sides of mouth, and pharynx.

11. Disarticulate one of the halves of the inferior maxilla, raise it and detach the gum; make a section of the free borders and see whether there exist four alveolar dental compartments.

12.[4] Open the knee-joint, divide the cartilage of the lower extremity of the bone in thin sections, perpendicular to the axis of the bone; find and measure the point of ossification. (Fig. 7, Pl. IV.)

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[1] Chartier: "Examen Médico-légal et Autopsie des Enfants Nouveau-nés," Lyon, 1890.

[2] Vibert: "Précis de Médecine Légale," Paris, 1893.

[3] Cattell: "Some Special Points on the Performance of Autopsies on the Newborn," Annals of Gyn. and Pædiatry, 1893, p. 758.

[4] Numbers 10, 11, 12, can be more conveniently done at the conclusion of the examination.

13. See if there are marks of violence in the deeper parts of the neck; extravasations of blood, muscular tears; detach the carotids from the base of the neck to their bifurcation, and see if ecchymoses exist on their external surface or tears of the internal coat.

14. Open the larynx and trachea; note if they contain any froth or foreign bodies; condition of the mucous membrane.

15. Open the œsophagus.

16. Examine the condition of the spinal column.

17. Incise the skin, beginning at the base of the neck, passing downward over the thorax outside the nipple, down over the abdomen to the pubes, and pass upward on the other side. Avoid wounding the intestines and abdominal organs. The anterior wall of the abdomen being raised, divide the anterior and lateral attachments of the diaphragm, divide the ribs at the line of the cutaneous incision with strong scissors or a costotome.

18. Note the volume of the lungs, condition of the large vessels of the thorax (fulness, emptiness, injection of walls).

19. Cut across the trachea and œsophagus at the base of the neck; take out *en bloc* the lungs, heart, and thymus.

20. Examine the surface of the lungs; note their color, the presence of subpleural ecchymoses, patches of emphysema, or putrefaction. Punctate ecchymoses of the costal pleuræ and diaphragmatic aspect of thymus.

21. Plunge into the water the lungs, heart, and thymus, and apply the hydrostatic test.

22. Congestion of the lungs; quantity of blood and froth which exudes when a fragment is squeezed between the fingers.

Foreign bodies in the bronchi (blood, mucus, meconium, fæcal matters, etc.).

23. Condition of the heart; subpericardial ecchymoses; quantity of liquid or coagulated blood contained in its cavities.[1]

24. Separate the stomach by cutting the inferior extremity

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[1] In certain cases, it is better to open the heart when still *in situ;* it is easier then to appreciate the quantity of blood which it contains, a portion of which almost always escapes while the thoracic organs are being removed, and the hydrostatic test applied.

of the œsophagus and the middle portion of the duodenum: open it under water to see whether it contains air or gas; note whether the mucus is mixed with bubbles of gas more or less fine and numerous. Foreign bodies.

25. Examine the intestine; if it contains gas; quantity of meconium in the large intestine. Is the anus imperforate?

26. Liver; its degree of congestion; state of umbilical vessels.

27. Kidneys; uric acid infarcts.

28. Other abdominal viscera; anomalies.

29. Incision of scalp in a circular line passing above the ears; raise it. Sero-sanguineous tumor; its site and volume. Epicranial ecchymoses, abundant or not. Effusion of blood above or beneath the periosteum. Congestion of cranial envelopes.

30. Detach the periosteum and ascertain whether the bones are fractured. Note abnormal thinness, lacunæ, or fissures.

31. Open the cranium by means of a saw or strong scissors introduced through the anterior fontanelle and directed along the front parietal suture, then transversely behind, dividing the parietal and occipital bones. Note whether there is extravasation of blood on the surface of the brain.

32. Take out the brain and examine its different parts; note the degree of congestion of it and the meninges.

33. Open the spinal column by sawing through the bodies of the vertebræ. Examine the cord, especially the cervical portion.[1]

A very good way of examining the mouth and pharynx of new-born children in cases of suspected infanticide, has been described by Hubert.[2] His method is as follows: The usual section in the middle line over the sternum is prolonged through the soft parts of the under-jaw, that is, through the chin and under-lip. One blade of sharp-pointed scissors is passed immediately behind the alveolar process, in the middle line, from above downward, and the mandibula divided. The halves of the lower jaw can then be separated and thrown backward on each side, affording a complete view of the mouth and pharynx without disturbing any foreign body which may be located there. The tongue can be drawn forward or to one side as may be most convenient. The advantages claimed are facility of execution, thoroughness of investigation, with the minimum disturbance of the parts and disfigurement of the cadaver.

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[1] Opening the spinal column can very often be omitted. It is examined only if it is suspected that the neck has been twisted.

[2] Friedr. Blät. f. ger. Med., 1887.

It is sometimes difficult to find the ossific centres in the os calcis and astragalus. The following method is suggested by Dr. Wyatt Johnston, coroner's physician, Montreal: Make a single diagonal incision from the fold of the ankle-joint anteriorly, to the tip of the heel posteriorly. The section will pass through the ossific centres of the astragalus and calcaneum, or very close to them, avoiding the necessity of a number of sections.

ILLUSTRATIVE CASES—INFANTICIDE.

1. *Strangulation by the Umbilical Cord. Vierteljahrssch. f. ger. Med., xlvi., p.* 81 (Winter).—A patient, æt. 27, IIIpara, normal pelvis, head presenting in second position of vertex, membranes ruptured for ten days; duration of labor twelve hours. Head arrested in pelvis for eight hours, when pains, which had been very strong, ceased. Forceps applied, but difficulty in delivering on account of cord coiled around the neck. Child born dead.

Post-mortem, seven hours after birth. Skin of whole head and face dark-blue and œdematous, especially about the eyes. A broad circular mark about the neck. In *cranial cavity*, veins distended with blood. Membranes and brain-substance very œdematous—no fluid blood in ventricles and cranial cavity, cranial bones intact.

Thorax : lungs collapsed ; deep dark ecchymoses over both pulmonary pleuræ in their whole extent and over the pericardium. Lungs airless but contain much blood. Trachea free, but mucous membrane very hyperæmic. Epiglottis œdematous, so that the opening of larynx was almost covered over. Liver congested, hemorrhage in the kidneys.

2. *Strangulation by the Cord—Hemorrhage in Lateral Ventricles. Ibid.* (Winter).—IIpara, æt. 21. Normal pelvis; hydramnios. After twelve hours of weak pains, the membranes ruptured and the waters came away with meconium. Four hours later came the head, but the midwife could not deliver the shoulders on account of the cord being coiled around the neck. In five minutes a physician came and cut the cord and delivered a child deeply asphyxiated, which was partially resuscitated, breathed imperfectly, and died in eight hours.

Post-mortem, ten hours after death. In the cranial cavity the sinuses were distended with blood, and under the pia mater was a lot of clotted blood which had flattened out the brain substance. Vessels of pia engorged, brain substance soft, both lateral ventricles filled with blood-clot. Medulla much flattened with fluid and clotted blood. Much serum in both pleural cavities. Ecchymoses on pleura and pericardium. Small extravasations under the mucous membrane of false vocal cords. Lungs collapsed and almost airless. Ecchymoses in kidney.

3. *Large Intracranial Hemorrhage—Death in Five Days. Ibid.* (Winter).—Vpara, twins. The first born spontaneously, head presenting. The second turned by external cephalic version and delivered spontaneously in six hours. In the second child, soon after birth, ptosis of the right upper lid was noticed, and weak general convulsions. It could not move or swallow and died in five days.

Post-mortem, twenty-four hours after death. A large clot compressed brain in right frontal and parietal regions; brain substance softened; no wounding of sinus could be found or the point whence hemorrhage came.

4. *Airless Lungs in Well-Developed Child that Lived Six Hours. Ibid.* (Winter).—IIIpara, æt. 23. Spontaneous birth; child cried after birth but grew gradually weaker and died in six hours.

Post-mortem, twenty-four hours after death. Membranes of brain deeply injected, especially the pia. Brain-substance soft and congested, lungs dark-bluish red, airless, somewhat lighter in color at the edges. Sank in water. Ecchymoses in pleura, especially of lower lobe.

5. *Air in Stomach and Intestines of Dead-Born Child. Ibid.* (Winter).—IXpara, æt. 36. Early rupture of membranes, tedious labor, transverse presentation; physometra, child died in utero; version and extraction. No attempt at resuscitation.

Post-mortem in twenty hours. Many large and small ecchymoses on pericranium, pia injected, great œdema of cerebral membranes. Many ecchymoses in brain-substance. Lungs collapsed, bluish-red, airless, ecchymosed, a few patches containing air found on section. Mucus mixed with meconium found in trachea. Stomach and whole intestinal canal nearly as far as the colon filled with air. In the lower part, no meconium. Both kidneys congested, with hemorrhage into the connective tissues.

6-9. *Four cases of death from natural or accidental causes, in which appearances existed which might have been mistaken for evidence of criminal interference.*

6. *Death from Cerebral Hemorrhage during Labor—No Signs of Violence. Unpublished* (Wyatt Johnston).—The body of a well-formed new-born male infant was found wrapped in heavy wrapping-paper. Around the body was a torn white cotton cloth stained with meconium but showing no traces of blood or of having been wetted. There was a very large caput. Dissection showed a slight meningeal hemorrhage along the region of the fissure of Sylvius, and a blood-clot the size of an almond in the region of the medulla. The lungs were

airless and sank in water; the stomach empty and airless. Meconium in both large and small intestines. No external marks of violence.

7. *Case of Syphilitic Hepatization — No Marks of Violence. Unpublished* (Wyatt Johnston).—Coroner's inquest held on the body of an immature male infant of about the fifth month. Cord had been tied and cut. Heart, surface pale and yellowish; portions of heart muscle examined under the microscope show a number of coarse, highly refractive granules in the muscular fibre, varying from 1 to 3 mm. in diam., insoluble in strong acetic acid, stained black but not intensely by osmic acid solution, and completely dissolved by chloroform, showing them to be probably some preliminary stage of degenerative fat. Lungs pale, and whitish-gray in color, lobulation very distinct, quite airless. Microscopic sections of lung show moderate amount of catarrhal exudate in most of the air-cells. Condition appears to be that of commencing white hepatization.

8. *Child Born Enveloped in Membranes—Injury to Head by Fall on Floor. Unpublished* (Wyatt Johnston).—A coroner's inquest was held on a fœtus of about eight months. After the membranes had ruptured and the waters drained away, the fœtus enclosed in the amniotic sac with placenta attached was expelled in a single pain, the fœtus striking the floor with its head. The lungs were airless, but ecchymoses beneath the pleura and pericardium indicate that death was due to asphyxia, probably from the close adaptation of the membranes to the child's face. About the left parietal and occipital regions, there is a moderate amount of reddish serum beneath the scalp, and a few small ecchymoses beneath the pericranium in this region. On opening the skull, a thin layer of coagulum is seen covering the hemispheres at or about the site of the external injury.

9. *Accidental Suffocation by a curd of milk, probably vomited. Unpublished* (Wyatt Johnston).—A coroner's inquest was held recently on the body of a new-born child, found dead. The body was quite fresh, well-nourished, and at about the end of the eighth month. Umbilical cord 2½ inches long with line of demarcation formed, and retraction of vessels. No signs of violence externally or about mouth and pharynx. In the pharynx were small masses of curd; one of them, the size of a bean, was wedged in the larynx completely obstructing it. A little turbid fluid was found in the trachea. Stomach contained about a teaspoonful of acid curdy fluid, in which were found, microscopically, oil-globules but no traces of starch. Heart filled with thick fluid blood. No ecchymoses on pleura or pericardium.

10. *Was Death due to Hemorrhage from the Torn Cord, Exposure to Cold, or Violence? Eulen. Vierteljahrssch., N. F., xlii., p.* 315 (Langsdorff).—A widow, the mother of four children and near full term, set out to walk to a relative's house some miles away. She felt

pains before starting. While passing through a wood she was taken with active labor and bore a living child. She said that she cut the cord with her finger-nail and threw the placenta into the bushes, placed the child in a basket and covered it over with a cloth. The weather was cold and unpleasant, and when she reached her destination the child was dead but still warm. Upon examination, it was established that the child was born alive, had lived a short time, and died of suffocation, probably the result of violence, the mouth and nose being forcibly closed with the hand. The lung, stomach, and intestinal appearances were those of live-birth. The engorgement of the heart with blood, the congestion of the brain and viscera, and the numerous ecchymoses pointed to death by suffocation. About the nose, mouth, and chin were bluish discolorations and excoriations corresponding in situation and extent to the fingers and thumb of the mother's right hand. There were blue spots on the back of both hands, due to the mother's holding them in her left hand while the child was struggling for breath. Hemorrhage from the cord was excluded because the vessels were full of blood, not empty; and there was not a sufficient quantity of blood lost to cause the death of a strong child. Exposure to cold was excluded because the weather was not cold enough to freeze, and moreover the body was warm when she reached her relative's house. That death occurred soon after birth was proved by the relatively empty condition of the stomach, bowel, and bladder, as well as by the appearance of the stump of the cord. No food was found in the stomach. The stump was fresh, soft, and not beginning to dry; only the end was of a brownish color.

11. *Accidental Asphyxia by Fœtal Membranes.* (*Vibert: Précis de Médecine Légale, Paris,* 1893, *p.* 732).—Ipara, æt. 19, accused of infanticide.

Post-mortem on body of child: Cord and placenta still attached to the body. A piece of the membranes still adherent to the placenta, covered the mouth and nose entirely. No marks of violence on the body. No foreign matters in mouth and pharynx. Larynx and trachea contain a small quantity of colorless froth. Lungs fill the thoracic cavity and float on water. Ecchymoses on diaphragm, pleura, and pericardium. A number of blackish spots the size of a pea scattered regularly over the whole pulmonary surface. Cavities of heart distended with dark liquid blood; no clots. Stomach contains mucus and a small quantity of gas. Small intestine empty, large intestine filled with meconium. Liver large and congested. Spleen and kidneys normal; bladder contains a little urine. Scalp is unbroken, no effusion of blood beneath it. No fractures of cranial bones. Meninges are congested and pia mater presents a fine vascular injection. No effusion of blood within skull. The opinion given was that the child was at full term, was born alive, and died from asphyxia caused by the occlusion of mouth and nose by a portion of fœtal membranes commonly known as the the *caul.*

12. *Infanticide by Strangulation. Ibid., p.* 733.—Post-mortem on child born at full term. Putrefaction has not begun. Around the neck is a black lace, drawn very tight and secured with a double knot, it passes horizontally around the neck below the larynx. It leaves on the skin a deep furrow, blue in color, but not parchment-like. On the right side of the neck the furrow is double, with a ridge of skin between; red and projecting. No marks of violence on the face or other parts of the body. On dissection of the neck, an ecchymosis is found 7 mm. in diameter on the anterior surface of the trachea. On the left carotid, the internal membrane presents a tear occupying about three-fourths of the periphery of the vessel; an effusion of blood exists in the tissues on a level with this tear. Larynx and trachea empty, their mucous membrane being white, slightly reddened. Lungs are voluminous and float in water. Numerous fine subpleural ecchymoses. Heart ecchymosed and cavities distended with fluid blood. Stomach contains mucus and a little air. Liver bulky and congested. No fractures of cranial bones. On the surface of both hemispheres are extensive thin layers of coagulated blood. At the base about three to four grammes of liquid blood. It was concluded that the child had breathed and was strangled by a ligature tied tightly around the neck.

13. *Infanticide by Fracture of the Skull. Ibid., p.* 734.—Post-mortem on body of child which had reached full term. Cord is torn away at a point 17 cm. from the abdomen and not tied. Putrefaction has not begun. On various parts of the body, especially about face and neck, are wounds, erosions, ecchymoses, and other signs of external violence. No foreign bodies in mouth and pharynx. Larynx and trachea contain a little froth. No marks of violence in the deep parts of neck. Lungs bulky and congested and float in water. A dozen fine ecchymoses under pleura. Lung substance contains a large quantity of blood and froth. Heart contains liquid blood, but no subpericardial ecchymoses. Stomach contains mucus. No air in stomach or intestine. Large intestine filled with meconium. Liver large and congested. Under the scalp on right side is a large extravasation of blood mostly coagulated. Right parietal bone is broken into fine pieces, two of which are completely detached and depressed. Left parietal bone also fractured in a single line from the parietal protuberance to the sagittal suture. Beneath the skull is a blood-clot 1–2 mm. thick covering almost the whole superior surface of the right cerebral hemisphere; at the site of fracture it is thicker, irregular, and partly surrounds the fragments of bone. The conclusion was that the child was born alive and death was caused by fracture of the skull.

14. *Fracture of Skull during Delivery of Hydrocephalic Child. Trans. Obstet. Soc. London, xxix.,* 1887, *p.* 405 (Swayne).—A primi-

para had been a long time in labor; the first stage had been tedious, the waters having come away early. The head was found pressing down upon the perineum but not advancing on account of its large size. It was perforated in the sagittal suture, a quantity of liquid gushed out, the skull collapsed, and the child was then delivered without difficulty. It was found that the long-continued pressure against the pelvis had caused extensive ecchymosis around the left eye and a fracture of the right parietal bone.

15. *Was Death due to Injuries to the Head, Hemorrhage from the Untied Cord, or Suffocation (Drowning in a Stable Drain)? Eulenberg's Vierteljahrssch. f. ger. Med., i.*, 32.—The body of a new-born child was disinterred and examined by order of the court eighteen days after birth. It was full term and well developed, had been born alive and lived for a short time. There were several injuries about the head, a ragged wound on the scalp and fissures of both parietals. The lungs showed evidence of breathing, but the upper lobes were of a clear white color, the lower lobes clear and bluish, and over the surface were numerous small pale-red spots and marbling. Spleen, kidneys, and liver moderately full of blood; mesentery and omentum less so. Vena cava filled with bluish-red blood; the right heart contained more blood than the left. Two blades of grass were found in the upper part of the larynx.

The injuries to the head lacked the bloody appearance of the edges and neighborhood of the wound and other signs of having been inflicted during life. They were attributed therefore to violence during burial. Hemorrhage from the untied cord was excluded not only on account of its rarity, but also because the internal organs were congested and not bloodless as they would have been after death from hemorrhage; moreover there was no trace of blood about the end of the cord. The presence of the blades of grass could only be accounted for by supposing that they were drawn in during inspiration. Death was attributed therefore to suffocation, the child having lain for a time face downward in the fluids running along the stable drain.

16. *Accidental Death in Precipitate Labor. Brit. Amer. Journal of Med. and Phys. Science, i., p.* 116 (Sewell).—Mrs. B., æt. 30, married, Ipara. After a large fire in Quebec, which destroyed her home, she occupied a garret with two or three other families and some young men. When labor set in she bore her pains in silence throughout the night, from motives of delicacy. At daylight she went downstairs to a room occupied by a married woman. She had hardly seated herself upon the edge of a rather high chair when a severe pain seized her; the child was forcibly expelled before assistance could be given; it fell head foremost to the floor and was killed instantly. Two women were witnesses of the accident.

17. *Infanticide by Means of a Sponge. Lyon Médicale, Dec.* 4th,

1892. *Noticed in N. Y. Med. Journ., i.*, 1893, *p.* 167 (Prof. Cazeneuve). —An infant, æt. five months, died suddenly. Suspicion having been aroused, an examination of the body was made seven months afterward. In the intestines were found seven rounded bodies the size of beans, which proved to be pieces of sponge. They had probably been administered in milk or soup, the finger being used in the back of the throat to assist the swallowing. Convulsions set in and the child died in sixteen hours. Professor Cazeneuve states that in England infanticide is committed by forcing into the pharynx a sponge to which a string had been tied; after the child is dead the sponge is pulled out and no signs of violence are left.

18–20. *Three Cases of Infanticide from Stoppage of the Air-Passage with Soft Obstructions.* 18. *Vierteljahrssch. f. ger. Med.*, 1891, *i., p.* 19. *Smothering with a Feather-Bed.*—A full-term living child born during the night was found dead next morning. The post-mortem showed that it was mature, had breathed, and died of suffocation. There were no marks of violence. Nothing in mouth or upper air-passages. Nothing aspirated into lungs. Child had been heard to cry, and the mother said it had died soon after. There were three possible ways in which death might have been caused. Suffocation between the mother's thighs, under the bedclothes, or rolled up in the padded garment into which it was born. The mother was anxious to smother the child's cries; she found it hard to do this with her thighs, so she pulled down the feather-bed which served as an upper bed-cover, and wrapped the child in that.

19. *Smothering with the Mother's Hand.*—The child was new-born, mature, had breathed and lived, and then died of suffocation. What was the cause? The mother had already borne a child and this one's head was small, therefore labor was probably easy. She was not delivered in her bed, because she slept in a room with eight other girls, and the bed was not soiled and no clots of blood were found about it. Nor was the child born in the privy, for no traces of blood were found there. Probably in a sodded plot of ground before the house, but the marks were washed away by the rain. Post-mortem examination showed that death occurred immediately after birth. The lungs were but slightly distended. There were finger-marks on the left side of the neck, but not in such a position as to suggest strangling. Immediately after the child was born, the mother put her left hand over the child's mouth, and pressed her fingers against the left side of its neck, while she kept the air from entering the mouth.

20. *Wrapping in an Apron.*—A child was found in a basket wrapped up in an apron; there were some clothes on top, and the basket was covered with a woollen cloth. There were no marks of external violence, but the post-mortem showed evidence of slow suffocation. There were numerous ecchymoses and large effusions of blood under

the soft cranial coverings, unconnected with any traumatisms. There was a large amount of frothy, bloody mucus in the bronchi, therefore the opinion was given that the child was alive when it was wrapped up and placed in the basket.

21. *Case where the Plea of Accidental Death from Precipitate Labor was Successfully Refuted. Friedr. Blätter, xxxvi.*, 224 (Rauscher). A woman, æt. 30, while visiting a neighbor was seized with labor pains, went to the privy, and in a quarter of an hour came out and called to a person who was passing to hurry, for her child had come and had fallen into the privy. A living child was rescued, soiled with fæces, with a bluish swelling on the right side of the neck, and bleeding from the mouth. A physician testified that the swelling was due to strong pressure on the neck, the indented mark of one finger-nail being quite perceptible. The mother went back to the house from the privy, and a midwife extracted the placenta and attended to the child. The mother claimed that labor came on so rapidly that she could not get help, that the severity of her pain prevented her from rescuing the child, and that the injury to the neck came from its falling upon frozen fæcal matter in the privy. The person who removed the child from the pit said that she found it lying on its back; its back, heels, and back of head were covered with filth. The midwife testified that one hour after its birth the child was weak, bleeding from the mouth, and that the swelling on the right side of the neck was the size of a hen's egg, and increased or diminished in size according as blood flowed from the mouth. There were no scratches on left hand, back, or right temple. The cord was torn off and was about a foot long. Next day when she returned the child was dead. The post-mortem showed a full-term child which had been born alive and lived for thirty-three hours in spite of severe injuries to the neck which caused such hemorrhage as to interfere with breathing and cause slow suffocation. The opinion was given that death was due to suffocation from bleeding caused by violence to the neck. Were the injuries accidental or purposely inflicted? The mother claims that she fell upon a harrow-tooth two days previously and might thus have injured the child. This explanation is untenable, because no signs of injury were found on her abdomen, pointing to such an accident. Could the child have fallen upon frozen fæces and injured its neck? It did not fall on its right side, because it was smeared with fæcal matter on the back, back of head and heels, not on the side. There were no signs of fæces on or about the right side of the neck and in the neighborhood of the swelling. There was no ground to prove the suddenness of the birth or the absence of ability to get help or save the child. The mother's story was proved to be false in every particular.

22–24. *Cases of Injuries from Schultze's Method of Resuscitation in Asphyxia Neonatorum. Vierteljahrssch. f. ger. Med., xlvi., p.* 83

et seq. (Winter).—22. A woman, æt. 26, Vpara, with lateral placenta prævia. Combined podalic version was performed, followed immediately by extraction. The child was deeply asphyxiated. Schultze's method was employed, but the child was not resuscitated. Post-mortem, the scrotum was found much swollen and dark-blue. When incised, black blood spurted out. Pressure on scrotum forced blood into abdominal cavity. The abdomen contained free blood, lungs contained air and floated on water. Some ecchymoses on the pleura. Trachea and bronchi free.

23. A Vpara bore a child spontaneously. Cord prolapsed. Child deeply asphyxiated, not restored after long-continued use of Schultze's method. At the post-mortem held twenty-four hours after birth, the sinuses and veins of the pia mater were found engorged, and a general capillary injection of the brain substance, which was soft. The abdomen contained much fluid blood. The peritoneal covering of the liver was completely separated; between it and the liver was a small amount of fluid blood. In one part of the left lobe, the peritoneal covering was completely torn through. In the left inguinal region and right lumbar region were large subperitoneal extravasations. Blood could be squeezed from the scrotum into the abdominal cavity, and vice versa. The lungs were somewhat collapsed, light-colored, anæmic, and contained air throughout. The third, fourth, and fifth ribs on the right side were fractured about 1 mm. from the epiphysis. No hæmothorax.

24. A IIpara bore twins in the 36th week. The first was born spontaneously, forehead presenting. The second presented by the breech, but was quickly and easily extracted. It was deeply asphyxiated and Schultze's method tried unsuccessfully. At the post-mortem there was engorgement of the sinuses and pia mater and an extravasation of blood beneath and behind the pia. The tabular portion of the occipital bone was broken away from the basilar portion. Both lungs contained air. Much fluid blood was contained in the abdomen. The peritoneum was separated from the convex surface of the liver and torn in several places. There was an extravasation of blood in the right inguinal region.

25-28. *Four Cases of Air Found in the Lungs of Dead-born Children. Vierteljahrssch. f. ger. Med., D. F., iii., p.* 30.—25. *Turning and Extraction—Dead-born Child with Lungs Distended—No Attempts at Resuscitation.* A IIpara, æt. 24, with a simple flat pelvis, was delivered of twins. The first came spontaneously, the second had prolapsed cord; podalic version was performed, the os not being fully open. Heart-sounds were good but gradually became weaker; after rapid extraction, heart was not beating. There was a deep depression on the left parietal bone. Post-mortem, ecchymoses were found on the pericardium. The lungs were well filled with air.

26. *Extraction in a Footling Case—Dead-Born—Air-Filled Patch in the Right Lung—No Artificial Respiration.*—Ipara, æt. 27, with a simple flat pelvis. Early rupture of membranes. Heart-sounds good till spontaneous delivery of breech. Extraction of upper part of chest was difficult through a narrow, rigid os. Arms freed with difficulty. Head delivered twenty minutes later. Deep depression on left parietal bone. Post-mortem, no ecchymoses on costal or pulmonary pleura nor on the heart. In upper lobe of right lung was a piece the size of a pea containing air. Vessels of pia moderately filled. No cerebral hemorrhage. The important point in this case is that the child was undoubtedly dead before extraction of the head was begun, so that air found its way to the child's mouth and thence to the lung, although no intra-uterine manipulations had been performed. Also the absence of ecchymoses is noteworthy, notwithstanding undoubted death by suffocation.

27. *Extraction in Breech Presentation—Rupture of Dorsal Spine—A Spot of Lung Containing Air in Left Lung of a Dead-Born Child.*—In a IIIpara, æt. 29, eight hours after the death of the child, a foot was seized and extraction begun. The delivery of the chest was difficult, the spine gave way, the thorax lengthened out and came easily as far as the shoulder-blades. Delivery of arms and head difficult. Post-mortem, numerous ecchymoses were found on pleura and pericardium. In the middle lobe of the right lung was a patch containing air. There was some tympanitis uteri. As the child had been dead for eight hours, air must have got into the lung either by the child's inspiring air which had entered the uterus during an examination, or from putrefactive gases in the uterus, or after death from mechanical force during extraction. This last supposition is generally denied. If it were possible for air to be forced into the lungs of a dead-born child during artificial manipulations, it would be necessary to admit the possibility of air being forced into the lungs in a similar manner during its spontaneous delivery.

28. *Turning and Extraction in a Transverse Presentation—Air Found in Both Lungs of a Dead-Born Child.*—Ipara, æt. 23, normal pelvis, thorax deeply wedged in. Liquor amnii drained away for two days. Turning and extraction. Child beginning to macerate. Post-mortem, a moderate number of extravasations under pleura and pericardium. Both upper lobes and middle lobes of right lung atelectatic. In both lower lobes numerous spots filled with air. In this case the air could easily get into the uterus; the liquor amnii was a long time away and repeated examinations were made.

29. *Case of Infanticide—Peculiar Mummification of the Cord. Liverpool Med. and Chir. Journ., July,* 1889 (Lowndes).—The body of a large mature child was found in a coal-cellar with a silk handkerchief tied so tightly about its neck that the finger could not be pushed

between it and the skin. The aspect of the umbilical cord was the most peculiar and interesting feature of the case. It was quite fresh for half an inch from the umbilicus; the rest, two and a half inches long, was completely mummified ; there was no trace of ligature. As the weather was cold, the body was remarkably fresh, and it was probable that the child had been born eleven or twelve days previously. It had breathed, but the stomach was empty. All the internal organs were more or less congested, proving that the child had not died of hemorrhage. The opinion was given that the child had lived at least twenty-four hours.

30. *Case of Infanticide—Had a Criminal Abortion been Produced? Annales d'Hygiène*, 1889, *xxi.*, *p.* 418 (Tarnier).—On November 1st, 1888, a cook, æt. 39, was arrested for infanticide. Several persons had noticed for some months that she was growing stouter, as if pregnant. She had been in the habit of giving out her soiled linen to a laundress, but had washed it herself for some months so that it could not be ascertained whether her courses had stopped or not. On the night of October 20th, she had got up out of bed and gone into a cow-stable or privy close by. The following morning she complained of migraine, went up to her room and shut herself up. In the afternoon, her door being open, a servant went in and found her lying down and looking very ill. The following morning she got up and went to work; her mistress remarking that she was very pale, accused said that she had her menses and had lost a great deal. On November 1st, the police found several spots of blood on the floor of her room and two chemises spotted with blood. A parcel of clothing soiled with blood was subsequently discovered. The accused admitted that she might be four months pregnant, but strenuously denied having been confined. On October 31st, she was examined by a physician, who found a sero-purulent discharge coming from the genitals having the odor of the lochia. The fourchette was torn 2–3 cm., the edges of the wound were healing. There were also some small excoriations in the vagina. The cervix uteri was soft, dilated, fissured, and admitted the introduction of a finger. The uterus was larger than normal. No striæ. Milk could be squeezed from the breasts. The opinion was given that the accused had been confined at least eight days. Another physician was instructed to examine the woman on November 3d, and gave it as his opinion that one of the two following conditions existed:

1. That the accused had been confined twelve to fourteen days previously, the lesions in the cervix and at the fourchette being due to delivery; or
2. That abortion, by external means, had been attempted by the accused, probably with the aid of an accomplice.

He inclined to the latter supposition for the following reasons:

(1) The cervix giving passage to a large head would have been torn

throughout its whole thickness, and not only exteriorly; it would not have retained the regularity noticed in the examination.

(2) The breasts would have been larger and containing more milk.

(3) Striæ would have been more pronounced.

(4) The vulvar tear would not have been single, without swelling distortion or distention of neighboring parts.

(5) Complicity cannot be proved, but would be necessary to produce the injuries observed.

M. Tarnier was then commissioned to give his opinion of the case from the reports of the two physicians submitted to him. His conclusions were as follows:

(1) The sero-purulent discharge from the genitals, the increased size of the uterus, the easy introduction of the finger into the cervix, the secretion of milk prove that the accused had been pregnant, but do not indicate the period at which the product of conception had been expelled.

(2) The absence of striæ, the breasts slightly enlarged and not tending to become flaccid, the milk in small quantity and flowing out only on pressure, the cervix incompletely torn, a single tear at the vulva without swelling, tearing, or distention of the neighboring parts are commonly enough seen in women confined at or near term. These facts do not prove that pregnancy had been terminated by abortion.

(3) The hypothesis of criminal abortion is rejected absolutely, for the lesions would have been different from those found in this case.

(4) After a spontaneous or criminal abortion, we would find neither an extensive tear of the fourchette, nor such lesions of the cervix, while such lesions are often found after labor at term, even if it is spontaneous and easy.

(5) The extent of the tear at the fourchette, the lesions of the cervix, the cicatrization still incomplete, prove that the accused was confined at or near full term.

31. *Infanticide—Fracture of Skull from External Violence.* 1889. *Sammlung ger. Gutacht, Berlin* (Becker).—A servant-girl bore a child, which was found dead in her bed in the morning. She claimed that after the child was born she tried to get something out of a chest to wrap it in, when she fell unconscious to the floor; the child may have fallen on the floor and struck its head. At the post-mortem, blood could be squeezed from the right ear. The right temporal region was swollen and blue, and on section much blood came away. On the left side of the occiput the scalp is swollen. The inner surface of the scalp is generally bloody, also the pericranium. A thick black extravasation of blood extends from the right ear to the occiput. The right temporal muscle is permeated with a quantity of blood, the

left is pale-red. On the left side of the occiput is a brawny swelling of the scalp and periosteum containing much blood. The cranial bones show four fractures: three on the left parietal bone, 3 to 5 cm. long, extending from the lambdoidal suture to the parietal protuberance; one on the right parietal bone, 5 cm. long, extending from the parietal suture over the protuberance. The brain was covered with blood. A quantity of free dark blood in and through the brain. A number of extravasation points in the brain-substance. The opinion was given that such injuries could not have been produced during a natural labor, especially as the pelvis was found to be of normal size, nor by a fall upon its head. The most probable explanation is, that the accused holding the child in her hands swung it so that its head struck several times and with great force against the foot of the bed or edge ofthe chest, upon which marks of blood were found.

32. *Case of Vagitus Uterinus. Edin. Med. and Surg. Journal, xxxiii., p.* 215 (Holmes).—On November 29th, 1828, I was called to a lady in labor of her sixth child. The fontanelle presented, but the pelvis being capacious and her labors generally easy, no attempt was made to change the position. The head continuing to descend, the mouth lay on the pubes and the examining finger could easily be introduced into it. The occiput did not yet occupy fully the cavity of the sacrum. At this time I heard sounds like the cries of a child whose mouth was muffled by some covering, but not being very distinct and not being at all prepared for them, I thought when they ceased that they must have been produced by flatus in the intestines of the mother. In the course of a short time, however, the cries were repeated and with the greatest distinctness, so as not to admit of a doubt that they proceeded from the child. The mother, much alarmed, inquired the cause of these noises, and required to be assured they were not indicative of any danger. The pains being brisk, the head was soon forced down and expelled. The child was a female and is still alive and thriving.

33. *Infanticide by Phosphorus Poisoning. Annales d'Hyg. Pub.*, 1868, *xxix.*, 117 (Tardieu).—There were signs of violent gastro-intestinal inflammation. Chemical analysis showed free phosphorus, sulfur, and red chromate of lead. There were a number of fragments of sulfur in the texture of the child's clothing. Thirty-four matches had been macerated in a watery liquid, nine having their tops scraped off with a sharp instrument. The fluid so prepared was administered to the child.

34. *Case of Attempted Abortion, Infanticide, and Successful Concealment of Birth.*—Ipara, æt. 26, of spare build and small frame. When two months pregnant, she took two ounces of oil of sandal-wood to produce abortion. She had convulsions and was very ill for some days, but was saved by prompt evacuation of the stomach. She went on to eight months, doing her work as a general servant without

exciting suspicion as to her condition. She says that she fell down stairs and was prematurely confined of a living child, but it is highly probable that she induced labor herself. She was alone when the child was born, and some time afterward the placenta came away. She wrapped the child in a cloth and then in newspapers, and went on with her work. Some workmen were filling in a drain which they had been digging in the yard; while they were away at dinner she buried the child in the excavation. and when they returned they filled in the earth and finished the drain. She felt ill and complained of pain for several days, but continued her work. On the eighth day she consulted a physician, who found a temperature of 100⅕°, and a purulent discharge, but no evidence of sepsis. She was sent to hospital, no suspicion having been aroused in the house as to her condition.

DETERMINATION OF SURVIVORSHIP.

BY

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DETERMINATION OF SURVIVORSHIP.

When a disaster occurs in which several persons lose their lives, questions frequently arise for the determination of the courts as to the devolution and distribution of property. In England and America (except in the State of Louisiana, which has adopted the fixed rules of the Civil Law enunciated in the Code Napoleon[1]), it is now well settled that "the survivorship of two or more persons must be established by the facts, and not by any arbitrary rule or prescribed presumption."[2]

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[1] The French law is analogous to the Roman Civil Law (Code Napoleon, Arts. 720, 721, 722. See article in Ir. L. T. reprinted in 14 Cent. L. J., 368, and quoted in 3 Wharton and Stillé, "Med. Jur.," 720; from which it appears, that as now modified the French law declares that in the absence of circumstances by which the fact of survivorship may be determined, it must be decided by the probabilities resulting from the age, strength, and difference of sex, according to the following rules: If those who have perished together were under fifteen years of age the eldest shall be presumed to have survived; if all were above the age of sixty years, the youngest shall be presumed to have survived; if some were under fifteen and some above sixty the former shall be presumed to have survived; if those who have perished together were above the age of fifteen and under sixty, the male must be presumed to have survived; where there was an equality in age, or a difference of less than one year, if they were of the same sex the presumption of survivorship, by which the succession becomes open in the order of nature must be admitted;—thus the younger must be presumed to have survived the elder. These provisions are a part of the Louisiana Civil Code, s. 930-939, and have there been construed in Gallier's Case, reported and annotated in 2 South. L. Rev., *n. s.*, 594. As stated in Newell *v.* Nichols, cited in note 2, *infra*, according to the law of India, where relatives perish together it is presumed that all died at the same moment and the property of each passes to his living heirs without any portion of it vesting in his companions in misfortune. And according to the Civil Code of Holland (Sec. 878), in the absence of evidence the presumption is that all persons die together at the same moment, and that there is no transmission or succession from one in favor of the other. See also Austrian Civil Code, 25. The same rule slightly modified has been adopted in California Code of Civil Procedure, sec. 1,963, Subdiv. 40. Saunders *v.* Simcich, 65 Cal., 50; Hallister *v.* Corden, 76 Cal., 649; And see Vol. 24, "Am. and Eng. Enc. of Law," Tit. Survivorship. Diligent examination does not disclose any statute in any of the other United States on the subject, probably because the rule of the common law as laid down by the courts is satisfactory.

[2] Per Van Vorst, J., in Newell *v.* Nichols, 12 Hun (N. Y. Sup. Ct.), 604-611, affirmed 75 N. Y. Ct. App. Rep., 78. The King *v.* Dr. Hay, 1 W. Bl., 640; s. c. 4 Burr

The rule of law deducible from the cases in England and America cited in the notes cannot be better or more clearly stated than it has been by Chief-Justice Church in Newell *v.* Nichols, 75 N. Y., 89, 90, as follows:

"The rule is that the law will indulge in no presumption on the subject. It will not raise a presumption by balancing probabilities, either that there was a survivor or who it was. In this respect the common law differs from the civil law. Under the latter certain rules prevail in respect to age, sex, and physical condition, by which survivorship may be determined, but nothing can be more uncertain or unsatisfactory than this conjectural mode of arriving at a fact which from its nature must remain uncertain, and often upon the existence of which the title to large amounts of property depends. In the language of the Lord Chancellor in Wing *v.* Underwood (4 DeGex, M. and G., 633): 'We may guess, or imagine, or fancy, but the law of England requires evidence.' There are cases where a strong probability in theory at least would arise, that one person survived another, and perhaps as strong as that that there was *a*

1,295; General Stanwix's case, referred to in the medical text below; Doe *v.* Nepean, 5 B. & Ad., 91, 92; Taylor *v.* Diplock, 2 Phillimore, 261; Calvin *v.* Procurator General, 1 Hagg. Ecc. R., 92; Matter of Goods of Selwyn, 3 *id.*, 74; Matter of Goods of Murray, 1 Curteiss, 596; Satlethwaite *v.* Powell, *id.*, 705; Mann *v* Mann, 1 Merin, 308; Underwood *v.* Wing, 19 Beavan, 459; s. c. on appeal before the Lord Chancellor, 4 DeG. M. & G., 633; s. c. (under name of Wing *v.* Angrave) in the House of Lords, 8 H. of L., 183. Elliott *v.* Smith, L. R., 22 Ch. Div., 236, criticised in 27 Solicitor's Journal, 49, article entitled, "Death of Several Persons Dying by a Common Calamity." And see also Woolston *v.* Berkly, L. R., 2 Ch. Div., 213; *Re* Wainwright, 1 Sw. & Tr., 257; Scrutton *v.* Pattillo, L. R. 19 Eq., 369; *Re* Ewart, 1 Sw. & Tr., 258; *Re* Grinstead, 21 L. T., *n. s.*, 731; *Re* Nichols, L. R. 2 P. & D., 361; *Re* Carmichael, L. R., 32 P. & A., 70; *Re* Wheeler, 31 L. J. P. & M., 40; *In re* Green, L. R., 1 Eq., 288, *In re* Phene, 5 Ch. App., 139; *In re* Lewis, L. R., 11 Eq., 236, all of which follow the rule laid down in Underwood *v.* Wing, *supra.* 2 Best on Evidence, 187, *ibid.*, Am. Ed. (13th ed.), sec. 30, n. 2; and see also the following American cases: Coye *v.* Leach, 8 Metcalf (Mass.), 37; Smith *v.* Croom, 7 Fla., 81–180; Pell *v.* Ball, 1 Cheves Eq. (S. Car), 99; Vol. 3, N. Y. Legal Obs., p. 269; Moehring *v.* Mitchell, 1 Barb. Ch., 270; Stinde *v.* Ridgway (N. Y. Sup. Ct., Sp. Term, 1878), 5 How. Pr. Rep., 301; Freeman *v.* Kellogg, 4 Redf. Surrogate's Ct. Rep. (decided by Calvin, Surrogate, in 1880), 218; Russell *v.* Hallett, 23 Kans., 276; Ehles Estate, 73 Wis., 445; Wentworth *v.* Wentworth, 71 Me., 72; Johnson *v.* Merrihew, 80 *id.*, 111; *Re* Hall, 9 Cent. L. J., 381; Fuller *v.* Linsee, 135 Mass., 468; Cowman *v* Rogers, 73 Md., 403; Paden *v.* Briscoe, 81 Tex., 536; Cook *v.* Caswell, *id.*, 678; all of which cases substantially follow the English common-law rule as expounded in England in Underwood *v.* Wing, and New York State in Newell *v.* Nichols.

survivor, and yet the common law wisely refrains from acting upon it in either case. It is regarded as a question of fact to be proved, and evidence merely that two persons perished by such a disaster is not deemed sufficient. If there are other circumstances shown tending to prove survivorship, courts will then look at the whole case for the purpose of determining the question, but if only the fact of death by a common disaster appears they will not undertake to solve it on account of the nature of the question and its inherent uncertainty. It is not impossible for two persons to die at the same time, and when exposed to the same peril, under like circumstances, it is not as a question of probability very unlikely to happen. At most the difference can only be a few brief seconds. The scene passes at once beyond the vision of human penetration, and it is as unbecoming as it is idle for judicial tribunals to speculate or guess whether, during the momentary life-struggle, one or the other may not have ceased to gasp first, especially when the transmission of title to property depends upon it, and hence in the absence of other evidence the fact is assumed to be unascertainable, and property rights are disposed of as if death occurred at the same time. This is done not because the fact is proved, or that there is any presumption to that effect, but because there is no evidence and no presumption to the contrary. The authorities are uniform upon this doctrine, but the expressions of some of the judges in announcing it are liable to be misunderstood as indicating a presumption of simultaneous death which is not the rule. For instance, Sir William Wynne said: 'I always thought it the most natural presumption that all died together, and that none could transmit rights of property to another.'[1] Sir John Nicholl said: 'I assume that both perished in the same moment.'[2] In the matter of Selwyn,[3] the Court said: 'But in the absence of clear evidence it has generally been taken that both died in the same moment.' Sir Herbert Jenner said: 'The parties must be presumed to have died at the same time.'[4] These expressions only mean that as the fact is incapable of proof, the one upon whom the *onus* lies fails, and persons thus perishing must be deemed to have died at the same time, for the purpose of disposing of their property. The Lord Chancellor in Wing *v.* Underwood (*supra*) recognized the distinction, and explained the meaning of the rule. In commenting upon a similar expression of the Master of the Rolls to the effect that he must assume that Mr. and Mrs. Underwood both died together, the Chancellor said: 'From personal communication with his Honor I know that he is not aware that he ever used such an expression, and all he ever meant to say was that the property must be distributed just as it would have been if they had both died at the same moment.' And Mr. Best, in his work on Presumptions, after laying down the general rule, states that it is not correct to infer from this that the law presumes both to have perished at the same moment, and adds: 'The practical consequence is, however, nearly the same, because if it cannot be shown which died first, the fact will be treated by the tribunal as a thing unascertainable, so that for all that appears to the contrary both individuals may have died at the same moment. All the common-law authorities are substantially the same way, and the rule, which I think is wise and safe, should be regarded as settled.' "

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[1] Rex *v.* Heass, 2 Salk., 593; 2 Phill., 296, note c.; 5 B. & Ad., 91, 92.

[2] Taylor *v.* Diplock, 2 Phill., 261.

[3] 3 Hagg., Ec. R., 748.

[4] Curties, 705.

DETERMINATION OF SURVIVORSHIP.

It is the intention of the writer to keep the medical distinct from the legal view of the subject, except in so far as reference to legal cases may be necessary to illustrate and emphasize the points under consideration.

The writer wishes to emphasize the belief, that the question of survivorship cannot in the present state of medical knowledge, and from the inherent difficulties of the subject, be treated in a dogmatic and positive manner. As will be seen, the conditions which affect such cases are so variable that positive conclusions cannot be drawn from them, and each case must be decided upon the evidence obtainable in such case. In short, the determination of survivorship requires the recognition and accurate interpretation of certain conditions which, singly or combined, produce a given result. Modify a single condition, or the combination, and an entirely different result is obtained, so that in proportion as the conditions vary, the conclusions become either difficult or unattainable.

Given a case where two or more persons have met their death by a common accident; what are some of the conditions which, rightly interpreted, aid in determining the question of survivorship?

1. **Degree of Danger.**—It is so obvious that the greater the danger the more likely is the effect to be lethal that nothing further need be said. Again, in the matter of injuries and wounds, the more vital the region injured, the more dangerous is such injury, and this regardless of the extent and other characteristics of it in many cases. Thus, an apparently insignificant puncture of the abdominal wall may occasion death where an extensive lacerated wound of the thigh, or even loss of that member, would not seriously jeopardize the life of the individual so injured. The degree of danger, therefore, depends upon factors differing in kind, and each of which must be given consideration and assigned its exact rôle in each case.

2. **Age.**—The real importance of age, *per se*, in questions of survivorship is not easy to measure. It is so intimately connected with the mode of death that it is often difficult, and even useless, to consider them separately. This is particularly so in the case of adults. It is commonly and probably correctly assumed that between the ages of twenty-five and fifty years, the power to withstand lethal agencies is practically the same, so far as age alone is concerned. Further, that, in adult life, the individual has greater powers of resistance than in youth or old age. However, here, as elsewhere, we can find exceptions to this in, for instance, the greater power of children over adults to withstand heat and thirst. In one case, say severe injury with hemorrhage, youth would predispose the individual to earlier death than the adult; in the other case, say extreme heat or prolonged thirst, youth would act to give it an advantage over maturer years. Thus, we have an exemplification of what has been previously asserted, viz., that when conditions vary so greatly, our conclusions may be erroneous, unless carefully made, and we can more readily understand how other coincident conditions may be so closely related to age that they must be reckoned at the same time.

3. **Sex.**—It is commonly presumed, that the male, being stronger than the female, will survive longer than she. Strength, however, must not be confounded with endurance, and perhaps more often the possession of the latter is most useful in preserving or prolonging life, when threatened. In the matter of endurance, women have demonstrated over and over again their ability to withstand the severest physical ordeals, and it is certainly a debatable question, whether they have not in the main even more resistance than man. This seems, indeed, clearly established in some causes of death, as we shall see later on. Sex, like age, is closely related to other conditions, and, like the latter, must often be considered with them to ascertain its full import.

4. **Constitution.**—Obviously, a delicate constitution must yield sooner than a strong one, for strength and endurance are less quantitatively and qualitatively. Again, the form of weakness and the cause of death may be such as to unite in bringing about an earlier fatal issue than would be the case were the cause of death different. For instance, an individual suffering

from some disease, producing embarrassment of respiration, would succumb to suffocation sooner than a person equally weak in every other respect but from some other trouble in which the respiration was only relatively affected. Indeed, age, sex, and constitution are scarcely separable in questions of survivorship and must usually be considered in relation to each other to give each its due share of influence. A good illustration of this is the well-known Stanwix case.[1]

"In 1766, General Stanwix and daughter set sail in the same vessel from Ireland for England. They were shipwrecked, and not a single person on board was saved. The representative of the personal estate of the father was the nephew, and the representative of the daughter was her maternal uncle. These parties brought thé case into Chancery. On behalf of the nephew whom the general's survivorship would benefit, it was argued, that the ship being lost in tempestuous weather, it was more than probable that the general was upon deck, and that the daughter was in the cabin, and subject to more early loss of life than the general, who, as a man of arms and courage, was, it was asserted, more able and more likely to struggle with death than a woman. Further, it was argued that he might probably have been assisted in his struggles by the broken masts and other parts of the rigging. On the other side it was contended that the general was old, and consequently feeble, and by no means strong enough to resist the shock of such a terrible attack, while the daughter was of a hale constitution, and, being younger than her father, was proportionately stronger. It was contended therefore that the probability of survivorship was infinitely in favor of the daughter. A second wife of General Stanwix also perished with him, and her representative brought forward a separate claim to the disputed property. The Court, finding the arguments on all sides to be equally sound and ingenious, waived giving any decision, and advised a compromise, to which the several claimants agreed."

5. **Mode of Death.**—Of the many ways in which death may come to persons, a few are sufficiently common to not infrequently require consideration on the question of survivorship.

(*a*) DROWNING.—Where the bodies are recovered, examination of them may make it clear which one survived the others.

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[1] Beck, 1860, vol. i., p. 643.

Where no recovery has been made, known ability as a swimmer of some one of those drowned, age, sex, constitution, and position at the time of accident, in case of shipwreck, will be the factors meriting inquiry. Thus, in a sinking ship, those on deck have an advantage over those in the cabin; again, men, being less timid than women, are more apt to be on deck, and having the advantage in the matter of dress and muscular strength, could in such a case make a better fight for life. The position of the bodies at the time of recovery is also of importance. Positions suggesting efforts to save others favor the presumption of their survivorship. The presence of injuries in and of themselves serious, when found upon the bodies of those drowned, may kick the balance against the probable survivorship of some one apparently favored by the other conditions. For instance, given two persons thrown into the water, the one a good swimmer and otherwise physically strong, the other inferior in every respect. The former strikes with his head upon some hidden object and is rendered unconscious immediately and speedily drowns. In such a case, the latter survives the longer and with the majority of advantageous conditions against him. Injuries may have a different meaning. They may have been caused by the efforts to ward off death, under which circumstances they would indicate survivorship over those whose bodies bore no such evidences. Again, the character and amount of clothing, the power to resist cold, the presence of available wreckage upon which to cling, and many other circumstances peculiar to a given case could come into play to aid in the solution of the question.

(*b*) SUFFOCATION.—Among the conditions already enumerated, two are of especial importance in this connection. They are, position of the body, and the presence or absence of wounds. Of a number of men suffocated under the debris of some fallen structure, the one who is nearest the surface and upon whose body are the fewest and most trivial wounds, and other evidences of injury, is in all probability the one who died last. This was exemplified in a case quoted by Tidy,[1] where it is related that a large sugar warehouse, having its floors unduly strained, collapsed, burying the workmen in the ruins. The men were found dead in proportion as the debris was cleared away. Those nearest the top escaped with injuries more or less severe; while those working on the second and ground floors were for the most part dead. Whether or not additional injuries, due to the increased weight of the debris, were present and contributed to the death of the victims, the report does not say. The inference is, that death was due to suffocation and not to coincident injury.

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[1] Brit. and For. Med.-Chir. Rev., p. 189.

(*c*) ASPHYXIA FROM IMPERFECT VENTILATION OR FROM POISONOUS GASES.—Among other things must be noted, testimony regarding toleration from long exposure to certain gases in dilute form, as in the case of workmen in certain employments; the position of the bodies in connection with the specific gravity of the gas and their proximity to its source, and the vigor and sex of the parties.

Concerning the vigor of a person as an advantage in threatened death from asphyxia, Tidy makes the following significant observation, that while vigor and muscular strength may help a person to reach a place where most oxygen is to be found, this demand for and effort to obtain air is probably in proportion to its want, while the want is rendered greater by the intensity of the effort, and that inactivity may in the long run be of decided advantage to persons threatened with asphyxia.

Regarding sex in this connection, it is noteworthy, that many cases are recorded where a man and a woman have been exposed at the same time to similar deadly gases, with the result that the evidences were unmistakable of the survival of the woman beyond the time of death of the man. This is possibly due to the fact that women consume less oxygen than men and can therefore exist longer in an atmosphere containing a minimum amount (relatively speaking) of oxygen than can men. Proximity to the place from which most air can be obtained is probably the most important factor in determining survivorship in cases of asphyxia, and evidences of possible air-supply should always be sought for.

(*d*) STARVATION.—Age, constitution, adipose, and the use or non-use of water are the principal factors to be considered. The aged, requiring less food than adults, can survive longer without it. The same is true of adults as compared with children. Again, women consume less food than men, and hence bear starvation better and longer. The fatter the body, the longer it can live upon itself; hence, other things being equal, the fat can outlive the lean. The ability to live many days (thirty and more) upon water alone makes it important to know whether or not water has been obtainable. Of two persons, one denied both food and water and the other food only, the latter would most surely survive the former.

Again, as in the case of threatened death from asphyxia, passive exercise or inactivity is advantageous, for the reason that in this way tissue-change is less rapid, and hence the resources of the body are economized. When food is given but water denied, children seem to bear the loss of the water better than adults.

(*e*) COLD.—Other things being the same or equal, adults bear cold better than the young or the old, and men better than women. Important modifying circumstances may come into play, however, such as the amount and kind of clothing, the stoutness of the individuals concerned, and the state of nutrition, habitual addiction to alcoholic or other stimulants or the use of narcotics, prior to the exposure to cold. The advantage of clothing and fat in keeping out the cold and in retaining the warmth of the body is obvious. Again, half-starved or over-stimulated tissues with the concomitant lessened nervous force, and tissues already benumbed by some narcotic, are easily overcome by cold.

(*f*) HEAT.—The effect of heat upon the young and old demonstrates their superior resistance to it as compared with that of adults. In the case of children, for instance, we commonly see them recover from diseases attended with a temperature so high, that did it occur in an adult it would usually mean death. In a similar way they bear heat from external sources, if it be dry and unattended with loss of cutaneous surface. In the writer's experience, severe scalds or burns, in the case of children, where the skin has been damaged over an inconsiderable area, are often rapidly fatal, causing death in twenty-four hours, where a similar extent of injury (relatively) in an adult would not cause death until the fifth or sixth day. The nervous system in childhood is much more impressionable and not so resistant of shock, and hence, probably, the greater fatality of burns in that period of life.

(*g*) Electricity (Including Lightning).—The increasing use of electricity in one form or another makes death from this source of more or less common occurrence. Presumably the general tone and vigor of the body increase its resistance to the effects of this agent, but upon this subject we have as yet much to learn. Conditions to be estimated are the completeness of the circuit and the voltage, the degree of moisture, the condition of the clothing, whether torn or not, and the state of metallic substances carried about the person, whether fused and rendered highly magnetic.

(*h*) Poisoning.—Several factors need to be considered; among which are the state of the health of all concerned at the time of exposure to the effects of the poison, the age, known idiosyncrasies, the kind of poison and the amount ingested. The question as to what constitutes a lethal dose of a given poison not infrequently arises, and is often exceedingly difficult to answer, because of the varying tolerance of individuals who are apparently similar in a physical sense. Age too has its influence in certain cases; for instance, children have a relatively great tolerance for belladonna, and this circumstance might go far to offset the many disadvantages incident to tender years and permit the child to survive a much older person who may have been similarly poisoned at the same time. Furthermore, it is to be ascertained if any evidence exists of addiction to a drug to such an extent as to cause a habit. It is a matter of common observation that the body soon becomes tolerant of drugs (opium, arsenic, strychnia, etc.) in doses which are ordinarily lethal, and hence the ability to withstand their effects for a longer time than in the case of those not having the advantage of previous tolerance is to be presumed. Obviously then, given two persons to whom have been administered lethal doses of opium, that one who has been accustomed to the drug will long survive the other.

(*i*) Death by Parturition.—When mother and child die during parturition and there have been no witnesses of such death, the presumption is strong that the mother has survived the child. The child should be examined for such evidences as would indicate still-birth, and the mother for any signs predisposing the child to the same; breech presentation, large head, prolapsed cord, lungs void of air, indicating that the child has never breathed. Then it must not be forgotten that at such time the mother could give but little assistance in helping to preserve the child's life. All these circumstances make it presumable that the mother outlives the child. On the other hand, the possibility must be borne in mind that a mother attempting to tie the cord of her child, and care for it in other ways, may die from the effort necessary to do this.

Some years ago a case came under the personal observation of the writer which fairly well illustrates this possibility: a vigorous and opinionated young woman from motives of economy did not secure the services of either a physician or a midwife at the birth of her fourth child. After tying the cord, she was seized with a violent and alarming hemorrhage, which might easily have terminated her life except for the timely assistance of a cool-headed and intelligent neighbor until medical aid was secured. (See POST-MORTEM PARTURITION, Vol. II., p. 369 *et seq.*)

(*j*) **Position.**—This is so often related to other conditions, as we have already seen, that little more need be said. It is of great importance to ascertain all the significance that position may possess, as it often affords a most important link in the chain of evidence. That body found nearest a source of intense heat or a poisonous exhalation, or farthest from the surface where air is obtainable, in all probability died before one more advantageously situated, and so cases might be multiplied in which the point of vantage would presume the survivorship of the one possessing it. It must be remembered, however, that such position may imply earlier death from the very efforts necessary to obtain it, and, hence, position alone should not make the sole basis from which our inferences are to be drawn.

(*k*) **Stage of Putrefaction.**—In the case of bodies recovered some time after death, the various stages of putrefaction noted may aid in determining a question of survivorship. This requires a knowledge of these stages and of the time necessary for their development under ordinary conditions. Furthermore, modifying circumstances must be understood and their rôle correctly estimated. Among these are the media in which the bodies lay, whether dry or moist, warm or cold, the amount of adipose, the existence of disease and its nature prior to death, the habits in the matter of alcohol of the individual, the age, kind of death, etc., all of which modify in more or less degree the putrefactive process and cause deviations from the normal, if, indeed, there be any standard which may be so designated.

(*l*) **Time of Death.**—Where the exact time of death of one of two or more persons and that of the other or others is only presumptive, the evidence obtainable must influence the decision. Illustrative of this is the often-quoted case of Hugh Swinton Ball,[1] as summarized by Tidy as follows: "On June 14th, 1838, Hugh Swinton Ball, his wife, and adopted daughter were lost on board the steamer *Pulaski* off the coast of America. An explosion took place at 11 P.M., the husband and wife being in different parts of the vessel. Mr. Ball *was not seen after* the explosion, although the exact time of his death was not known. Mrs. Ball *was seen afterward*, rushing about frantically, and calling for her husband. She was soon missed, however, the deck where she was going under water; all were lost. By will Mr. Ball had left his property to his wife, and her heirs now claimed it on the ground that she survived her husband. The defendants argued that as the time of the wife's death could be fixed, while that of the husband's could not, it was fair to presume that she died first. Chancellor Johnson decided for the plaintiffs (viz., that Mrs. Ball survived her husband). He admitted the *onus* was on the plaintiffs to prove that she survived, but he considered the fact that Mr. Ball did not appear after the explosion, while his wife was seen and recognized, was sufficient. On appeal this decision was affirmed." (See TIME OF DEATH, Vol. I., p. 439 *et seq.*)

Indeed, the whole subject contains many inherent and often insurmountable difficulties which only the growth and development of science can remove. Fortunately, thus far the question of survivorship in respect to several persons found dead together has been one of great rarity, and the opportunities few and far between of applying our knowledge of medical science toward its solution.

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[1] American Journal of Medical Sciences, July, 1845.

FORENSIC MEDICINE.

BIOLOGICAL.

WHEN MEDICAL EXAMINATION OR OTHER INSPECTION OF LIVING HUMAN BODY IS PERMITTED OR REQUIRED BY COURTS OF LAW

BY

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WHEN MEDICAL EXAMINATION OR OTHER INSPECTION OF LIVING HUMAN BODY IS REQUIRED OR PERMITTED BY COURTS OF LAW.

IN CRIMINAL CASES.

IN criminal cases it frequently becomes necessary for the criminal courts to determine questions of capacity to commit crime arising in cases of alleged infancy, idiocy, or lunacy. At common law, infants under the age of seven years were presumed to be entirely incapable of possessing the intelligence to know and understand the nature and quality of a criminal act, or to possess the necessary amount of will power to formulate a criminal intent. Infants between the ages of seven and fourteen years were presumed incapable of possessing these qualifications for committing crime, not as a matter of law but as a matter of fact, and the presumption thus arising, like any other presumption of fact, could be overcome by evidence establishing, beyond a reasonable doubt, that the infants did in fact know and understand the nature and quality of the act and that it was unlawful. Persons over fourteen years of age were presumed to be fully capable of committing crime.[1]

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[1] Some of the United States have changed the ages of capacity from those prescribed by common law; thus: Colorado—Infants under ten years of age presumed incapable as a matter of law; ten to fourteen as a matter of fact (Col. Gen. Stats., sec. 1,159). Minnesota—Infants over seven and under twelve years of age presumed incapable as a matter of fact (Minn. Stats., 1891 ed., sec. 5,966). New York—Infants between seven and twelve years of age presumed incapable as a matter of fact (New York Penal Code, sec. 19). Texas—Infants between nine and thirteen years of age presumed incapable as a matter of fact (Texas Penal Code, art. 34).

INSPECTION OR EXAMINATION IN CASES OF INFANCY IN CRIMINAL CASES, ETC.

The question of non-age was at the earliest period of the common law tried by a jury of eight men (Glanvil, L. 13, Chap. 15); but, as Blackstone states (3 Blacks. Comm., 332), "when for the greater expedition of the cause in some point or issue, being either the principal question or arising collaterally out of it, but being evidently the object of senses, the judges of the court upon the testimony of their own sense shall decide the point in dispute. For, where the affirmative or negative of a question is matter of such obvious determination, it is not thought necessary to summon a jury to decide it; who are properly called in to inform the conscience of the court in respect of dubious facts; and therefore when the fact, from its nature, must be evident to the court either from ocular demonstration or other irrefragable proof, there the law departs from its usual resort, the verdict of twelve men, and relies on the judgment of the court alone. As in case of a suit to reverse a fine for non-age of the cognizor, or to set aside a statute or recognizance entered into by an infant; here and in other cases of a like sort, the writ shall issue to the sheriff commanding him that he shall constrain the said party to appear, that it may be ascertained, by the view of his body by the King's justice, whether he be of full age or not; '*ut per aspectum corporis sui constare poterit justiciariis nostris, si prædictus A. sit plenæ ætatis necne.*' If, however, the court has upon inspection any doubt of the age of the party (as may frequently be the case) it may proceed to take proofs of the fact; and particularly, may examine the infant himself upon an oath of *voire dire*, *veritatem dicere*, that is to make true answer to such questions as the court shall demand of him; or the court may examine his mother, his godfather, or the like." So also in U. P. R. R. Co. against Botsford (141 U. S. Reps., 250, 252), the United States Supreme Court said: "In former times the English courts of common law might, if they saw fit, try by inspection or examination without the aid of a jury the questions of the infancy or of the identity of a party," and cited in support of the statement the doctrine quoted from Blackstone above. In the States of New York and Minnesota the practice in such cases has been regulated by express legislative enactment.[1]

CASES OF INSANITY, IN CRIMINAL CASES.

The practice in cases where a defendant in a criminal action pleads insanity, or where he apparently becomes insane after he has been indicted, will be fully considered in the article on Insanity in the next volume of this treatise. It is sufficient, however, to say now that this practice is regulated in the most of the United States and in England and her colonies by express statutory provisions, which in some instances require the question of insanity when occurring after indictment to be tried by a jury, and in others to be tried by a jury where it existed before indictment and by a commission where it occurred after indictment. Some of these statutes require that a portion of the jury or commission should be medical men, or that medical men should be required to examine the defendant and testify before the court or jury.

Of course the common-law practice of trying an issue raised by a plea of insanity, alleged to exist at the time of the commission of a crime, that is, to try it the same as any other issue of fact, by jury, is the universal practice in such cases.[2]

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[1] By section 19, New York Penal Code, it is provided that "whenever in any legal proceeding it becomes necessary to determine the age of the child, the child must be produced for a personal inspection to enable the magistrate, court, or jury to determine the age thereby, and the court or magistrate may direct an examination by one or more physicians whose opinion shall also be competent evidence upon the question of age." By Minn. Stats., 1891, sec. 596, the court is given power to require the production of a child for examination by a magistrate, court, or jury, to determine its age, and may require an examination by one or more physicians whose opinions are declared to be "competent evidence on the question of age."

QUÆRE: How far this common-law practice and these statutory enactments may conflict with the provisions of Art. 5, United States Constitution, providing that no person shall be compelled in any criminal case to be a witness against himself.

[2] It may be well to note here as showing the position of the different States in regard to this important matter of requiring an examination by physicians as to the sanity of prisoners, the provisions of the statutes of the following States, which recognize the necessity of participation by medical experts in such examinations: Alabama Code, sec. 4,817, provides that the judge must call "a respectable physician," and other credible witnesses, and if he deems it necessary, may call a jury. Delaware, Laws of 1883, chap. 77—Sanity of persons confined in jail, when doubtful, to be inquired into by "three judicious and competent persons" of county appointed by the court. Maine, Rev. Stats., ed. of 1883, chap. 137, sec. 5—In case any inmate of a State

PREGNANCY IN CAPITAL CASES.

When a female convicted of a capital offence, and sentenced to the punishment of death, apparently *becomes* pregnant, it has been the rule in all civilized countries to ascertain by proper inspection and examination whether she is so pregnant, and, if she is found to be so, to suspend sentence until after she has given birth to her child. In some instances in some States and countries this examination is required to be made or participated in by medical men, and in others there is no special provision in that respect, but it is the practice of the court to summon before the court or jury trying the case medical experts who have had an opportunity of making a physical examination of the defendant.[1]

The early common-law rule of practice was to empanel a jury of matrons *de ventre inspiciendo*. Of this practice Wharton, in his work on criminal law, sec. 3,402, observes: "In the frequency of capital punishments in the old English practice, it was not uncommon for female prisoners to claim the benefit of the law that no woman should be executed while

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prison or a county jail becomes insane, "two skilful physicians" may be appointed by court to inquire, etc. Michigan, Rev. Stats., ed. of 1882, sec. 1,909; see also Laws of 1893, No. 124—When any one under confinement, except by virtue of civil process, appears insane, the court or judge "must call two physicians to inquire, etc." After careful examination it is believed that the foregoing are the only States which require examination by physicians in such cases; but the practice has been universal to summon physicians as witnesses, where the sanity of persons confined in prison or jails is in question.

[1] Arizona Penal Code, secs. 6, 1,845, 1,846, requires a jury of three physicians. California Penal Code, sec. 1,221, a jury of three physicians. Dakota, United States Territory—probably reenacted when the States of North and South Dakota were formed—Compiled Laws, 1887, secs. 7,489, 7,491, a jury of three physicians. Idaho, Rev. Stats., secs. 8,017, 8,018, a jury of three physicians. Massachusetts, Public Stats. of 1882, chap. 215, sec. 34—"Must appear to the satisfaction of the Governor and Council," who would undoubtedly summon physicians. Minnesota, Stats. of 1891, sec. 6,883—"to the satisfaction of the Governor," who would undoubtedly call a physician. Mississippi, Code of 1892, sec. 1,450, "six physicians, if to be had; if not, six discreet householders. Missouri, Rev. Stats. of 1889, sec. 4,248, a jury of six, at least three of whom must be physicians. Montana, Compiled Laws of 1887, div. 3, sec. 380, "six jurors, at least three of whom must be physicians." Nevada, Gen. Stats. 1885, sec. 4,343, "a jury of three physicians." Oklahoma, Stats. 1893, sec. 5,308, "a jury of three physicians." New York, New York Code of Civil Proced., sec. 500—Sheriff of county where conviction takes place must empanel a jury of six physicians to inquire as to pregnancy.

she is quick with child. The practice under such circumstances was for the woman, when called prior to sentence, to say whether she had anything to allege why sentence of death should not be passed upon her, to plead orally her pregnancy, upon which the sheriff was forthwith directed to empanel a jury of matrons. The jury being sworn to inquire as to whether the prisoner is "quick with child," they retired with the prisoner, and the court was governed by their verdict to the same extent that it would be by the verdict of a jury empanelled to try any issue of fact. In the hearing before the jury, surgeons may be called to testify as experts. If the verdict be found in the defendant's favor, she is respited from session to session until the delivery of the child." [1]

IN CIVIL CASES.

Disputed Heirship.

The writ *de ventre inspiciendo*, says Blackstone, was also allowed by common law, in a matter of civil right, to protect the rightful succession to the property of a deceased person against fraudulent claims of bastards, when a widow was suspected to feign herself with child, in order to produce a supposititious heir to the estate, in which case the heir or devisee might have this writ to examine whether she was with child or not, and, if she was, to keep her under proper restraint till delivered (1 Bl. Com., 456; Bac. Ab. Bastard, A). "In cases of that class the writ has been issued in England in quite recent times. *In re* Blackmore, 14 Law Journal, N. C., Ch. 336." [2]

The learned court further said in the Botsford case: "But the learning and research of the counsel for the plaintiff in error have failed to produce an instance of its having been considered in any part of the United States as suited to the habits and condition of the people." In Roberts *v.* O. & L. C. R. R. Co., 29 Hun, N. Y., 154, 156, the court, *per* Learned, P. J., remarked: "The writ *de ventre inspiciendo* (1 Bl. Com., 456), taken by the English law from the Roman Dig., 25, 4, 1, 10,

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[1] See also 4 Black. Comm., 395; 1 Hale P. C., 369, 370; Reg. *v.* Wycherly, 8 C. and P., 262; State *v.* Arden, 1 Bay. Rep. (S. C.), 487; Haleman *v.* State, 13 Ark., 105.

[2] U. P. R. R. Co. *v.* Botsford, 141 U. S. Rep., 253.

and made indecent in taking, has long become obsolete," and the same observation is made by the same court concerning appeals of mayhem and the like, which are mentioned in 3 Bl. Com., 332, 333, referred to *supra*. There is, therefore, under the modern system of administering justice, no special or peculiar method or practice in use for determining cases of disputed heirship.

CASES OF IMPOTENCY, ALLEGED IN ACTIONS FOR DIVORCE.

In Devenbagh *v.* Devenbagh, 5 Paige, 554, the Court of Chancery in New York State held that in an action for divorce on the ground of impotency the court had power to compel submission by the plaintiff to a surgical examination, placing the opinion on the ground that from the very nature of the case other proof was impossible.[1]

INSANITY IN CIVIL CASES.

The practice in this class of cases, that is, commissions *de lunatico inquirendo* and the like, is, as in criminal cases, generally regulated by statutes, which will be collated and referred to fully in the article on Insanity in Vol. III. The general rule is that proceedings for determining the sanity of a person, in order to have a committee appointed to care for his person or property, must be had before a court or jury, but, as we have seen, in cases of inquiry where criminals were alleged to be insane, there is a lamentable insufficiency of provisions for a proper examination by medical experts.[2]

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[1] Roberts *v.* O. & L. C. R. R. Co., *supra;* 2 Bishop Mar. Div., sec. 590. And in the Botsford case above cited, the court said that this authority rests upon the interest which the public as well as the parties have in the question of upholding or dissolving the marriage state, and upon the necessity of such evidence to enable the court to exercise its jurisdiction, and is derived from the civil and canon law as administered in the spiritual and ecclesiastical courts, not proceeding in any respect according to the courts of the common law; citing Briggs *v.* Morgan, 2 Hagg, Con. 324; s. c. 3 Phillimore, 325; LeBaron *v.* LeBaron, 35 Vermont, 365. And see also Beck's "Med. Jurisprudence," 89, in reference to infrequency of cases of absolute or incurable impotency; and see Browne on "Divorce," 5th edition, p. 195.

[2] In Connecticut (Gen. Stats., 1888, sec. 3,683), the inquisition is referred to a jury consisting of *a physician*, an *attorney at law, a judge or justice of the peace, and one other person*. Under the Georgia Code, 1882, sec. 1,853, the question of insanity is determined by a jury of not less than twelve nor more than eighteen, at least one of whom must be a physician. In Ill. Rev. Stats., 1891, p. 85, secs.

EXAMINATION OF PLAINTIFF IN CIVIL ACTIONS TO RECOVER DAMAGES FOR PERSONAL INJURIES.

In Vol. I. of this treatise, Chapter VI., p. 85, etc., we said: "It has been much discussed whether the defendant in malpractice or other negligence cases can compel the plaintiff to permit his person to be examined by physicians before trial, to enable the defendant to know the full extent of the injury so far as it is presentable. In the latest cases the examination of plaintiff before trial was not allowed." Citing Roberts *v.* O. & L. R. R. Co., 29 Hun, 154; U. P. R. R. Co. *v.* Botsford, 14 U. S., 250; McQuiggan *v.* D. L. & W. R. R., 129 N. Y., 50. And we further observed: "On the whole, more good than harm would seem to be the probable outcome in permitting such examinations in malpractice cases, if not in all cases of alleged personal injuries." Since this was writen, the legislature of the State of New York, by chap. 721 of the Laws of 1893, has amended sec. 873 of the Code of Civil Procedure, providing for the examination of a party before trial to enable the defendant to prepare for trial, so as to give the power to the court of granting an order to direct "that the plaintiff submit to a physical examination by one or more physicians or surgeons to be designated by the court or judge, and such examinations shall be had and made under such restrictions and directions as to the court or judge shall seem proper. In any action brought to recover damages for personal injuries, where the defendant shall present to the court or judge satisfactory evidence that he is ignorant of the nature and extent of the injuries complained of, the court or judge shall order that such physical examination shall be made. The order must require the party or person to be examined, to appear before the judge or before a referee named in the order, for the purpose of taking the examination at the time and place therein specified."

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4 and 6, one of the jurors for the trial on an inquisition of insanity must be a physician. Kan. Gen. Stats., 1889, sec. 3,667, provide for a jury of six men, one of whom must be a physician. Minn. Stats., 1891, sec. 5,887, requires a jury of two persons, one of whom must be a physician. New York Code of Civ. Proced. requires a jury of not less than twelve nor more than twenty-four indifferent persons, or a trial jury in a court of record, but there is no provision for examination by a physician or that a physician should be summoned to sit on the jury.

It will thus be seen that the legislature of the State of New York has recognized the propriety and desirability, for the furtherance of justice in actions to recover damages for personal injuries, of enabling the defendant, if he satisfy the court that he is ignorant of the nature and extent of the personal injuries complained of as having been suffered by the plaintiff, to have the plaintiff examined, under proper restrictions, by a competent physician designated by the court. The importance and value of this provision to the medical profession in malpractice cases cannot be over-estimated.[1]

REFUSAL OF PLAINTIFF TO SUBMIT TO MEDICAL EXINATION, WHEN ADMISSIBLE IN EVIDENCE.

An interesting question arises in those States in which an inspection and examination of the person of the plaintiff in personal injury cases is held by the courts not to be permissible without plaintiff's consent, as to whether the refusal of the plaintiff to submit his person to an examination can be shown upon the trial for the purpose of permitting the jury to draw the inference that the plaintiff was not as severely injured as he claimed. In Elfers *v.* Wooley, 116 N. Y., 294, the court held, that a charge to the jury that it might take into consideration the fact that the plaintiff had refused to permit his person to be examined by a physician, when requested to do so by the defendant, as bearing upon the credibility of the plaintiff's statement concerning his injuries, is not error. The court also held that it was not error for the trial court to refuse to charge the jury that the refusal of the plaintiff to submit to such an examination raised a presumption that his injuries were not as severe as he claimed; putting the decision upon the ground that the charge above quoted was as favorable as the defendant could ask. It appears, however, from inspection of the printed record on the appeal in that case, that no objection was taken to the admission of the evidence concerning the plaintiff's refusal to submit to an examination. Hence the evidence being before the court without objection it might well be said that it was for the jury to determine what force and effect should be given to it. It seems to the writer of this article, that where there is no statute permitting the courts to require such an examination, and hence where it is held, as in the Botsford case and the McQuiggan case, cited above, that the refusal to submit to such examination is a matter of right, evidence that the plaintiff did so refuse should not be held admissible or permitted to militate against him upon the trial of his case. On the other hand, where there is a statute, as in New York, permitting the court to order an examination by a physician whom it designates, it would certainly seem to be the law, that the refusal of the plaintiff to submit to such an examination could be proved against him on the trial, in addition to any remedies the court might have for enforcing its order requiring an examination to be had.

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[1] See Elwell on "Malpractice, Medical Evidence and Insanity," chap. 6, containing digest of the reports of Prof. F. H. Hamilton, on Deformities after Fractures, published in vols. viii., ix., and x. of the "Transactions of the American Medical Association;" also see Boston Medical Journal, vol. xxxi., p. 501. Probably other States will follow the example of New York State in passing similar statutes. The Section of the New York Code of Civil Procedure which is amended by the Statute of 1893, referred to in the text, relates to taking the deposition of a party to an action before trial. In the case of Lyon *v.* The Manhattan Railway Co., decided May 1st, 1894 (58 N. Y. St. Rep., 860), the New York Court of Appeals held, that in construing amendments to a statute, the original statute, with all its amendments, must be read together, and viewed as one act passed at one time. No part is to be held inoperative if all can be made to stand and work together; and hence that the amendment of 1893 did not authorize an order directing a physical examination apart from, and independent of, an examination of the plaintiff as a witness before trial. The Court in its opinion remarks: "How is it possible for medical experts to make a physical examination in a case like this, or indeed in most cases, by merely observing the external marks or indications of diseases? The term itself implies not only such observation, but an inquiry by means of questions and answers as to the cause, nature, character, and extent of the disability. Mere external appearances are, in themselves, of no consequence unless identified and connected with the accident as the cause, and, hence, disclosures such as ordinarily occur between patient and physician must necessarily accompany the inspection of the parts."

The Court did not directly determine the question of the constitutionality of the act requiring a party to submit to a physical examination.

PREGNANCY, LABOR, AND THE PUERPERAL STATE.

BY

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PREGNANCY, LABOR, AND THE PUERPERAL STATE.

THE DURATION OF UTERO-GESTATION.

In this connection four topics are of interest:

I. What is the normal period of utero-gestation? Protracted gestation.

II. The diminished duration of pregnancy, with the question of viability.. Live birth.

III. Resemblances. Mother's marks.

IV. Substitution of children. Supposititious children.

So far as medical evidence concerns legitimacy, there are two important medico-legal questions for solution. These are:

I. The average duration of pregnancy and protracted gestation.

II. Diminished duration of pregnancy; premature delivery; period of viability; live birth.

I. AVERAGE DURATION OF PREGNANCY AND PROTRACTED GESTATION.

By the actual **duration** of pregnancy we understand the time that elapses between impregnation and labor. Owing to the fact that, as we shall show, a period of from one day to more than a week may elapse between insemination and impregnation, we are simply unable to estimate the exact date of conception.

Further, given a first and only cohabitation, it is impossible for any one to state positively whether or not the ovum subsequently impregnated (1) was discharged at the time of the last menstrual period, (2) is the product of an intermenstrual ovulation, or (3) is one corresponding to what would have been the next menstrual period had not the woman become pregnant.

"The **real duration** of pregnancy in the human female is accordingly an unknown quantity."[1]

We learn from experience, however, that the average apparent duration of pregnancy is ten lunar (nine calendar) months, or forty weeks, or two hundred and eighty days from the beginning of the last menstrual period, or two hundred and seventy-two days from the date of conception.

In the human subject, and even in the lower animals, the determination of the exact date of conception is by no means a simple matter. In woman it is only in very exceptional cases that the date of a fruitful sexual intercourse can be obtained.

Among the 5,010 women examined by Winckel[2] in reference to this point, but 1,700 or a little over one-third could give any information whatsoever. Even in those cases where impregnation follows the first and only coitus, certain physiological conditions render us liable to error.

Conception or impregnation is accomplished by the union of the male element—the spermatozoid—on the one hand, and the female element—the ovum—on the other; but we have no way of determining how long after the spermatozoids are deposited in the genital canal of the female their union with the ovum occurs. Pregnancy or gestation does not begin until such union is effected.

The ovum is discharged from the ovary during ovulation, and ovulation may or may not coincide with menstruation. The spermatozoa are deposited in the vaginal canal during sexual intercourse, and if there is no ovum in the canal above (uterus or Fallopian tube) ready to be impregnated, we have every reason to believe that the spermatozoa may remain in the genital organs of the woman, with sufficient vitality to impregnate the ovum when it does appear, for a limited period after coitus.

RELATION BETWEEN MENSTRUATION AND IMPREGNATION.

Milne Murray,[3] records a case in which insemination occurred a few hours before menstruation began and was followed by pregnancy and delivery two hundred and seventy-two days later. The menstrual period was perfectly normal and no subsequent coitus occurred. The interest in the case rests in the fact that the process of menstruation does not apparently interfere with the passage of the spermatozoa through the uterine cavity. Unless the spermatozoa travel much more rapidly than we at the present day believe they do, they must in this case have been caught in the menstrual flow, which began within two hours after they were thrown into the vagina. The spermatozoa must, therefore, have forced their way against the downward current of the menstrual blood, and have reached the Fallopian tube in good time to fertilize the discharged ovum.

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[1] Jaggard: "Amer. System of Obstet.," vol. i. J. Veit: Zeitschr. f. Geb. u. Gyn., Bd. viii., p. 234.

[2] "Text-book of Midwifery," 1890, p. 94.

[3] Edinburgh Med. Journal, September, 1892.

Duncan says in this connection, that where a fertilizing insemination takes place just before the period is due, the latter frequently "does not take place at all, or only very scantily; the uterine system, as it were, anticipating the conception and preventing the failure which might result from a free discharge of blood."

It is quite evident that such cases occurring in married women would be very liable to be considered "cases of gestation protracted a month." In the case referred to in this article the period was a perfectly normal one, in no way differing from any of those that had immediately preceded it.

Bossi[1] states that from a series of observations on the wives of sailors, and the results of artificial impregnation, he is of the opinion that the most favorable time for impregnation is immediately following menstruation. He finds that the spermatozoa, contrary to the general supposition, retain their vitality in the vagina for at *least* seventeen days, even through a menstrual period.

B. Haussmann[2] found in the cervix of a woman, seven and a half days after the last cohabitation, spermatozoa that showed their vitality under the microscope by their movements.

Percy[3] found them eight and a half days after sexual intercourse.

They have been found with vitality eighty-two hours after death in criminals who have been executed; in the genital canal of bitches and rabbits, eight days after intercourse; and in the cow, six days.

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[1] Nouvelles Archives d'Obstetrique et de Gynecologie, Paris, April. 1891.

[2] "Ueber das Verhalten der Samenfäden in den Geschlechtsorganen des Weibes," Berlin, 1879.

[3] American Med. Times, March 9th, 1861.

The spermatozoa are endowed with motion, and partly by their movements, partly by contractions and expansions of the cervix and uterus, as well as by capillary action, they ascend through the genital canal until the ovum is reached. As has been already stated, they may be in a condition to impregnate this ovum seven or more days after being deposited in the vagina.

So much for the male element. It will be readily seen that even in those exceedingly rare cases where there is but one cohabitation from which to date the commencement of pregnancy in order to compute its duration, we may be liable to error to the extent of at least one week. In other words, it may require one week or more for the spermatozoids to reach and fertilize the ovum.

Now let us turn to the female element—the ovum—and the question that first suggests itself to us is: When is the ovum liberated from the ovary?

We have no direct proof that sexual intercourse causes either the ripening or the discharge of the ovum, although there seems little doubt that the sexual orgasm may result in the bursting of a ripe Graafian follicle and the consequent entrance of an ovum into the Fallopian tube. Sexual congress may have this effect upon the discharge of an ovum from the ovary, but such congress is by no means necessary or essential for the liberation of the ovum, for it is quite certain that the discharge of the ovum occurs whether sexual intercourse has taken place or not.

The Graafian follicles burst and the ova are thrown off with more or less regularity during ovulation. Ovulation is generally believed to coincide with menstruation. We are in the habit of speaking of the phenomena of ovulation and menstruation as occurring at one and the same time. Because both of these processes are more or less rhythmic, because they occur at or about the same intervals, and are "more or less closely contemporaneous,"[1] scientists have come to believe "that one process depends on or is initiated by the other."[2]

Three theories are held:

(1) Menstruation excites ovulation;

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[1] H. Newell Martin.

[2] *Op. cit.*

(2) Ovulation reflexly causes those changes or phenomena in the uterus called menstruation; or

(3) Finally, the two processes are absolutely independent, although they have certainly become associated.

Without going into the argument on either side, we may now accept the statement as a fact that menstruation and ovulation may occur entirely independent of one another. Women menstruate after the ovaries are removed, and on the other hand impregnation has occurred in women who have never presented any of the phenomena of menstruation, showing that ovulation must have occurred in the absence of menstruation.

From the foregoing it will be readily seen that a second difficulty stands in our way in calculating the commencement of gestation if—as we usually do—we date from a certain time marked by a menstrual period.

Enough has already been stated in this article for us to draw certain conclusions as to the uncertainty of calculating the exact duration of pregnancy:

1. Even where the date of the first and only cohabitation is definitely known, we are liable to error to the extent of at least one week, for we know that the spermatozoa may retain their vitality in the female genital organs for that time.

In this case either there is no free ovum in the genital canal or upon the surface of the ovary at the time of cohabitation; or, on the other hand, supposing there is a free ovum, a week or more may elapse before fertilization takes place. Here the usual number of days—272 to 275—added to the date of fruitful coition would leave us short by about a week.

2. Immediate impregnation may occur either by the fertilization of an ovum already free, or an acute sexual orgasm may result in the bursting of a Graafian follicle and the liberation of an ovum.

3. When we compute 280 days from the beginning of the last menstrual epoch as the duration of pregnancy, we lose sight of the fact that it is not always the ovum of this ovulation that becomes impregnated, but of that which would have been the next period, had not the woman become pregnant. In such an instance an *apparent* protraction of gestation to the extent of five weeks would be quite possible. Many so-

called cases of protracted gestation might be explained on this theory.[1]

His[2] examined sixteen embryos with the utmost care. He found that in twelve the stage of development proved that impregnation occurred, not at the time of the last, but at what would have been the next menstrual (first missed) epoch, had not the woman become pregnant. The remaining four embryos in their development corresponded to impregnation occurring at the last menstrual period.

Schlichting[3] investigated 456 cases and made the average to be 269.5 days, and yet the time varied from 240 to 334 days.

Winckel[4] gives us some of the most recent figures upon the subject. In his 5,010 cases examined he found 70 whose duration of gestation was more than 300 days, and 47 in whom the period was more than 302 days. He found further that in 6.8 per cent of those cases where the exact date of impregnation was known the duration was more than 300 days. In one case the duration was 314 and in another 318 days.

Krücke[5] reported a case where he believed the duration of pregnancy was 330 days.

A case is reported by Thomson,[6] in which gestation lasted 317 days from the last menstrual period, or 301 from the last sexual intercourse.

Loewenhardt,[7] from 518 cases in which the women could give the date of the successful coitus, found that the average duration of pregnancy from the date of conception was 272.2 days.

Leuckardt, in an analysis of 67 cases found upon the marriage-and-birth register of a church, in which labor occurred within ten months from the marriage night, computed the average duration of pregnancy to be 272.5 days.

Hasler,[8] from a large number of cases in which the date of impregnating coitus was known, estimated the average duration of pregnancy to be 272.24 days from the date of conception, and 280.5 days from the beginning of the last menstrual epoch.

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[1] This theory, known as Sigismund's, has many followers.

[2] "Anatomie menschl. Embryonen," Abth. I., v. ii., Leipzig, 1882.

[3] Arch. f. Gynäk., Bd. xvi., 210.

[4] "Text-book of Midwifery," 1890, p. 94.

[5] Deutsche med. Zeitung, von Grosser, 1883, 370.

[6] Trans. London Obst. Soc., vol. xxvii.

[7] Archiv f. Gyn., iii., 1872.

[8] "Ueber die Dauer der Schwangerschaft," Zurich, 1876.

Recently Issmer,[1] in an exhaustive paper upon the duration of pregnancy based on a careful analysis of 464 cases, has made the following interesting points:

1. Conceptions occurring in the first half of the intermenstrual period are to those in the second half as 72 to 27.

2. Pregnancies dated from the first half of the intermenstrual period are shorter in duration than those dated from the second half.

3. When impregnation occurs in the first half, the ovum fertilized is that which has been discharged at the last menstruation (ovulation); while, when it occurs in the second half, the ovum impregnated is one that escapes at or near the next menstrual period.

4. The average duration of pregnancy is 268 days from conception, or 278 days from the completion of the last menstruation. Maximum duration, 304 days.

Among the lower animals the rule holds good that the smaller the animal the shorter is the duration of pregnancy. Here also we find variations. Thus the average duration is for—

the rabbit,	30 days,	ranging from	27 to 35 days
“ cat,	56 “		
“ bitch,	60 “		
“ sow,	120 “	“ “	109 to 138 days
“ sheep,	154 “	“ “	146 to 158 “
“ cow,	285 “	“ “	240 to 320 “
“ mare,	340 “	“ “	287 to 419 “
“ giraffe,	444 “		
“ elephant,	625 “		

In the human subject authorities differ somewhat in giving the average duration of gestation. Thus (calculated from first day of last menstruation)—

Schlichting[2] (440 cases), . . .	gives 273.1 days
Matthews Duncan, ...	“ 278 “
Löwenhardt[3]-Ahlfeld[4] (166 cases),	“ 281.6 “

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[1] Arch. f. Gyn., xxxv., 1889, p. 310.

[2] Archiv f Gynäk., Bd. xvi., 210.

[3] *Ibid.*, Bd. iii., 456.

[4] Monat. f. Geburtsh., xxxiv., 180, S. 266.

Winckel[1] (5010 cases),	gives 280	days
Issmer[2] (464 cases),	" 278	"
Runge,[3]	" 280	"

All of these authorities found variations above and below the average of from 30 to 35 days.

How Long May Gestation be Protracted?

In Austria[4] the law recognizes the legitimacy of the child born within 240 to 307 days of the death of the father.

In France[5] "the legitimacy of the infant born 300 days after the dissolution of the marriage is liable to be contested."

In England and America[6] we find no absolute limit laid down. Each case is determined upon its merits. In America a liberal view is taken, and the legitimacy of births at the completion of 313 and 317 days respectively has been judicially decided. This limit of 317 days is, according to most medical authorities upon the subject, an extreme one.

The latest period to which pregnancy may be protracted is stated by various authorities as follows:

Depaul,	300 days	(high limit)
Robert Barnes,	300 "	(improbable)
Issmer,[7]	304 "	
Winckel,[8]	320 "	
Schroeder,[9]	320 "	
Schlichting,[10]	334 "	
Runge,[11]	320 "	

Winckel gives as his reason for his investigations into the duration of pregnancy the following medico-legal case. He says:

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[1] "Text-book of Midwifery," 1890, p. 94.

[2] Arch. f. Gyn., Bd. xvi., 210.

[3] "Lehrbuch der Geburtshülfe," Berlin, 1891.

[4] "Das k. k. Oesterreichische bürgerliche Gesetzbuch." "Amer. Sys. Obstet.," vol. i.

[5] L'article 315 du Code civil.

[6] "The light of the courts in this matter is reflected light. Physicians must determine the matter; and if the space between the minimum and maximum periods hitherto allowed is shown to be too long or too short, the courts will readily follow the truth as it is made manifest." (Wharton "On Evidence," sec. 1,300.)

[7] Arch. f. Gyn., Bd. xvi., 210.

[8] "Text-book of Midwifery," 1890, p. 94.

[9] "Lehrb. der Geburtsh.," 9te Aufl., Bonn, 1886, p. 109.

[10] Arch. f. Gyn., Bd. xvi., 210.

[11] "Lehrb. d. Geburtshülfe," Berlin, 1891.

"I undertook these observations at the instigation of the legal authorities, in order to determine the possible duration of pregnancy, because a man already divorced from his first wife, by reason of her adultery, still sought her punishment by civil process. A new trial of the whole case showed the weight and length of the child, which had been born 310 days after the last cohabitation, to have been great, and the possibility that the duration may have been 310 days had to be acknowledged, and the woman was acquitted because the imputed adultery could not be proved by the supposed duration of the pregnancy and the appearance of the child."

Reese[1] states that it is possible for pregnancy to be prolonged beyond the usual period accepted as the average, but he gives no limit. He agrees with Taylor that we must "be prepared to admit either that conception may, in some cases, be delayed for so long a period as five to seven weeks after intercourse, or that there may be a difference of from five to seven weeks in the duration of pregnancy."

Schroeder[2] says: "I myself do not doubt for one moment that a mature child can be born within 240–320 days of the last period."

Winckel[3] makes the following concise statement: "The result of this discussion, therefore, as far as obstetrical and legal practice is concerned, may be summed up as follows: The average duration of pregnancy is about 280 days; it may vary, however, from 240 to 320 days, and perhaps even exceed this latter limit, which is by no means so rare as was formerly supposed; for in 6.8 per cent the duration is over 300 days."

ILLUSTRATIVE CASES OF PROLONGED PREGNANCY.

1. *Silberstein: Wien. Med. Presse, vol. xx.*, 1887, 29, *p.* 943.—Protracted pregnancies and over-development of the fœtuses in the same mother. Case I.—Duration of pregnancy was 308 days from last menstruation; child weighed ten pounds; was fully developed—hair, nails, etc. Case II.—Duration of pregnancy 313 days; child weighed nine pounds; still-born.

2. *Schlichting, Fr. X.: Archiv für Gynäk., xvi.*, 1880, *2d pt.*,

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[1] "Text-book of Med. Jur. and Tox.," Phila., 1889.

[2] "Lehrb. der Geburtsh.," 9te Aufl., Bonn, 1886, p. 109.

[3] "Text-book of Midwifery," Phila., 1890, p. 94.

p. 203.—Statistics upon the onset of menstruation and on the length of pregnancy. Case of pregnancy which lasted 334 days; one that lasted 236; and another 205 days from last menstruation.

3. *Purkhauer, H.: Friedreich's Bl. f. gerichtl. Med., Nuremb.*, 1890, *xli.*, 191–193; and *Medical Chronicle, Manchester, July*, 1891. —A case of protracted gestation. Woman was very small; twice a mother; age 26; menstruated regularly. Last menstruation April 28th, 1889. Quickening last part of September. Delivery expected February 5th; occurred March 13th. Motions of child not felt after December. Child born alive; weight 8 pounds 13 ounces; length 21¼ inches. Dating fecundation from May 5th, gestation was of 316 days' duration; dating it from May 21st (seven days before end of expected menstruation), it was 300 days; that is, 36 to 20 days longer than usual. Smallness of mother's parts was thought to prevent fœtal movements; absence of fœtal movements might explain delayed uterine contractions.

4. *Lutz, Chr.: Bayer. ärztl. Intell. Bl., xxvi.*, 44, *p.* 475, 1879.—Dead child, born four weeks after usual time. Mother had had three other pregnancies protracted beyond 40th week.

5. *Jaffé, F.: Centralbl. d. Gynäk., Leipzig*, 1890, *xiv.*, 74–76.—Multipara; æt. 31; labor occurred 365 days after last menstruation. Conception supposed to have occurred eight to nine weeks after last menstruation; woman was subject to such intervals of amenorrhœa. If this was so, then pregnancy had lasted 303–309 days.

6. *Hergott, A.: Bull. Acad. de Méd., Paris*, 1889, *xxii.*, *pp.* 520–532.—Un cas de rétention fœtale. Fœtus died 45 days before operation. Absence of labor. Laparatomy on the 293d day of pregnancy, dated from last menstruation.

Conclusions:

1. Prolonged pregnancy is generally extra-uterine.
2. It is complicated with cancer.
3. Sometimes it is uncomplicated, as in the following cases:

(1.) *McBride:* Two cases. *Brit. Med. Jour., vol. vi.*, 1886, *p.* 853.
(2.) *Cork: N. Y. Med. Jour.*, 1883, *p.* 249.
(3.) *Frank: Boston Med. and Surg. Jour., Dec. 2d*, 1875.
(4.) *Hosmer: Boston Med. and Surg. Jour.*, 1881.
(5.) *Lee: Brit. Med. Jour., April 22d*, 1876.
(6.) *McDonald: Brit. Med. Jour.*, 1883, *p.* 13.
(7.) *Thomson: Lond. Obst. Trans., vol. xxvii.*, 1885, *p.* 309.
(8.) *Woodhouse: Dubl. Med. Jour.*, 1882, *p.* 13.
(9.) *Young: Edinb. Med. Jour., March*, 1864.
(10.) *Nunez: Amer. Jour. Obstet.*, 1886, *vol. xviii.*

7. *Casey, R. J.: Lancet, London*, 1873, *i.*, 293.—Case of pregnancy protracted to 350th day.

8. *Bryon, J. D.: St. Louis Med. and Surg. Jour.*, 1877, *xiv.*, 345–346.—Gestation prolonged to 342 days.

9. *McTavish, D. A.: N. Y. Med. Jour.*, 1889, *xliv.*, 413.—Case of pregnancy prolonged to 318 days.

10. *Mans, L. M.: N. Y. Med. Jour.*, 1889, *xlix.*, 519.—Remarks on prolonged gestation in the human female, with notes of a case extending over a period of 334 days.

11. *Graves, T. T.: Boston Med. and Surg. Jour.*, 1876, *xciv.*, 353. —A case of gestation extending to 306 days.

12. *Jefferis, D. W.: Trans. Med. Soc. Pa., Phila.*, 1879, *xii.*, 759.—A case of prolonged gestation; 358 days from the cessation of the menses to the delivery of the child.

13. *Henderson: Amer. Jour. Obstet.*, N. Y., 1879, *xii.*, 393–400.—Case of gestation prolonged to 15 months. Discussion.

14. *Renouf vs. Eden.*—(See *Med. Times and Gazette*, 1870, *i., p.* 290. Queen's Bench, Feb., 1870.) See Tidy, "Legal Medicine," "Action for Seduction." A child was born 307 days (or 44 weeks, minus one day) after the possibility of intercourse occurring between the parties. Verdict for the plaintiff. The case, however, was not decided upon the medical evidence, but on the ground that the plaintiff was entitled to damages, because he (defendant?) had induced the child to leave her mother's roof and had then seduced her."

15. *Duncan: Med. Times and Gazette, Dec. 29th*, 1877, *p.* 712.—(Quoted by Tidy.) "A case of pregnancy lasting 325 clear days, reckoned from the last day of menstruation. The woman's bulk when confined was enormous, and the child of more than usual size and weight. In three previous pregnancies it was said that she had carried the children 300 days in one case and 285 days in the other two cases."

16. *Gardner Peerage Case.*—Abstract of the cases before the House of Lords (Taylor's "Med. Jur.," Vol. II., p. 267). See also for more exhaustive accounts Beck's "Med. Jur.;" Tidy on "Legal Medicine;" Montgomery: "Signs and Symptoms of Pregnancy."

"Allan Legge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the Parliament roll. The peerage was, however, claimed by another person, Henry Fenton Jades, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate; and in order to establish this point the evidence adduced was partly medical and partly moral.

"Lady Gardner, the mother of the alleged illegitimate child, parted from her husband on board of his ship on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child whose legitimacy was disputed was born on the 8th of December of that year. Therefore, the plain medical question, taking the extreme view, was whether a child born 311 days (forty-four weeks and three days) after intercourse (from January to December), or 150 days (twenty-one weeks and three days) from July to December, could be considered to be the child of Lord Gardner. If these questions were answered in the affirmative, then it followed that this must have been a very premature or a very protracted birth.

"There was no pretence that this was a premature case, the child having been mature when born. The question then was reduced to this: Was this alleged protracted gestation consistent with medical experience?

"Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child.

"On the moral side of the question it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jades; and on this ground Lord Gardner obtained a divorce from her after his return. It was contended that the counter-claimant was really the son of Lady Gardner by Mr. Jades. The decision of the house was that this claimant was illegitimate, and that the title should descend to the son of the second Lady Gardner."

17. *Corn vs. McCarty*, 2 *Clark (Pa.)*, 356.—In this case the court said: "The organs of conception, like those of digestion, perform their appropriate offices without the volition of the female. She is not conscious at the moment of the occurrence of what has taken place. It is only by inference that she can fix the paternity of her offspring."

18. *Kilpatrick, A. R.: South. Med. Record, Atlanta*, 1875, *v.*, 338. Case of a dead fœtus retained in utero over four months; and cases of prolonged pregnancy.

19. *Cosentino, G.: Sicilia Med., Palermo*, 1889, *i.*, 30–41.—"Distocia per gravidanza diuturna." In this article three cases of alleged protracted gestation are recorded which caused difficult labor on account of the size of the children. Counting from the date of the commencement of the last menstruation the durations of pregnancy were respectively 311, 300, 287 days; the weight of the fœtuses was respectively 10, 15, 12 pounds.

20. *Ingleby, Mackenzie: British Gyn. Jour., London, Feb.*, 1890. —The woman was 32 years old, a primipara, married ten years, and had always menstruated regularly. The last menstruation before her confinement occurred April 28th. Fœtal movements were felt by her in September. False pains occurred in January. On March 8th, after a labor of sixty-six hours, she was delivered, her pregnancy having thus continued 314 days.

21. *Jaffé: Centralblatt für Gynäkologie, No.* 5, 1890.—A case of a multipara, in whom gestation lasted between 300 and 309 days.

The development and measurements of the child corresponded to the prolonged gestation.

22. *James P. Baker, Esq.*, of Indianapolis, cites the following in *Parvin's "Text-Book of Obstetrics"* (Philadelphia, 1886):

"Judges, like doctors, are liable to differ, and the decisions of courts have not been entirely harmonious as to the period of gestation. In the case of O'Brian *v.* the State *ex rel.* Swift, 14 Ind., 469, the Supreme Court of Indiana say:

"'Those who have investigated the subject, know that in the course of nature, a child living and capable of surviving to the ordinary age of man, may be born in seven, and may not be born until the expiration of ten, months from the cessation of the catamenia indicating the time of its conception.'

"The case of Duck *v.* The State *ex rel.* Dill, 17 Ind., 210, was a prosecution for bastardy. In such a case, the question always is: 'Is the defendant the father of the child?' Any evidence tending to show that any other man is the father is admissible. The child was born on September the 18th, 1858. On the trial the defendant offered to prove that the relatrix had had sexual intercourse with another person in the first week of November, 1857. The evidence was rejected. The Supreme Court held that this evidence was rightly rejected, and said:

"'It is true, experience proves that the period of gestation is almost as variable in individual cases, though within narrow limits, as that of the length of human life; but the longest period we have ever known to be judicially allowed was 313 days. See the case of Commonwealth *v.* Hoover, 3 Clark, Pa., 514. In the case at bar, the evidence might have covered a period of 322 days.'

"A still longer time was judicially allowed, however, in the case of the United States *v.* Collins, tried in the United States District Court for the District of Columbia, in 1809, and reported in Cranch's Circuit Court Reports, Vol. I., p. 592. The case was an indictment for not supporting a bastard child. The mother was received as a witness. The attorney for the government objected to the cross-examination as to her connection with other men than the defendant. The Court overruled the objection, but limited the time of inquiry to a period of not more than twelve months nor less than six months before the birth of the child. This is an extreme case. In Paul *v.* Padleford, 16 Gray (Mass.), 263, a bastardy prosecution, the Court refused to allow proof of acts of intercourse of the plaintiff with other persons than the defendant, at a time more than ten months and twelve days before the birth of the child. In Phillips *v.* Allen, 22 Allen (Mass.), 453, the Court said:

"'The child was born in eight months after the marriage, and the fact that a child is born thus soon after the husband had first access to the wife, does not prove beyond all reasonable doubt that the child is not his. There are ancient decisions that gestation somewhat more than nine months after the husband could have had access to the wife, does not disprove the legitimacy of the child. See Hargrave's note to "Coke's Litt.," 123 *b*, where these decisions are cited, and where in support of them the testimony of Dr. Hunter is introduced, expressing his opinion that gestation often varies from one to three weeks from nine calendar months, and that children are sometimes born in seven months from conception, and live and grow to manhood.'

"In Eddy *v.* Gray, 4 Allen (Mass.), 427, which was a bastardy prosecution, the Court below had admitted testimony tending to show illicit intercourse by the complainant with other men than the defendant at a period of time more than ten months before the birth of the child. The Court said:

"'Such testimony, in the absence of proof that the period of gestation extended beyond the usual duration, according to the common and natural course of life, which is recognized as well by legal as medical authorities, is inadmissible, and should have been excluded. See Co. Litt., 123 *b*, and note by Hargrave.'

"In the recent case of Ronan *v.* Dugan, 126 Mass., *p.* 176, a prosecution in bastardy, the Supreme Court of Massachusetts say:

"'In cases of this kind, the admissibility of evidence of illicit intercourse of the complainant with any other man than the defendant, depends upon the relation to the time when the child was born. In Eddy *v.* Gray, 4 Allen, 435, where the intercourse offered to be proved occurred more than ten months before the birth, the evidence was held to be inadmissible, without proof that the period of gestation was prolonged beyond the usual duration. We see no reason why the same rule should not be followed where the intercourse offered to be proved took place less than seven months before the birth, in the absence of the proof that the birth was premature.'

"In such a case the Tennessee Code limits the inquiry between the first of the tenth and the first of the sixth month next before the birth of the child. See Crawford *v.* The State, 7 Baxter, 41."

II. DIMINISHED DURATION OF PREGNANCY.—VIABILITY.—LIVE BIRTH.

An interesting question touching upon legitimacy is the possibility of a diminished period of gestation. The question for solution is: Can what is known as a fully developed child be born before the termination of the usual period of pregnancy, and how long before?

A husband and wife are for some reason separated for a long period of time—say two years. They are reunited and after a period of seven months, or perhaps a little more, an apparently fully developed child is born. Is this child legitimate?

Such cases as these are sometimes termed **precocious births**.

Medical literature contains numerous instances of women who habitually give birth to children at the seventh month, and yet we have no reason to believe that these children have any of the characteristics of the fully developed child. In these cases undoubtedly some pathological condition is the cause of the premature emptying of the uterus.

There seems to be no doubt that children at full term may differ as to length, weight, and other characteristics. We see an eight-months' child sometimes apparently better developed than another born at nine months. This is not the rule but the exception.

Hodge and Spiegelberg both taught that strong and vigorous children might be delivered before the completion of the nine months of gestation. It is the belief of the writer that, in a given case, where pregnancy has continued to within two or three (or possibly four) weeks of its completion, there may be some doubt whether the child born at that time be a full-term one or not, on account of the advanced stage of its development.

"In an English case, where the question of the legitimacy of a child was made to depend upon the period of the mother's gestation—259 days or 37 weeks (or three weeks lacking maturity), Sir J. Simpson gave evidence that a child born perfectly matured, three weeks before the usual term, could not be legitimate. This is certainly stronger ground than we would venture to take. To bastardize a child, and to impute the crime of adultery to the mother, because of the three weeks' prematureness of the birth, even though apparently mature, is, we think, an assumption not warranted by numerous facts" (Reese).[1]

There is no single characteristic or sign about a child recently born that will enable us to state positively how long the fœtus remained within the uterus. There are, however, a number of signs and characteristics which, taken collectively, enable us to state approximately the duration of intra-uterine life (see page 291).

[1] "Med. Jurisp. and Toxicol.," Phila., 1889.

VIABILITY OF CHILDREN BORN BEFORE TERM.

By the viability of a child we mean its capability of surviving. Medical authorities generally do not consider a child "viable" until it has reached the completion of the twenty-eighth week or the seventh lunar month of intra-uterine gestation. Seven and eight months' children may readily survive. Children born before the completion of the seventh lunar month may live a few hours or even days, but usually perish because their organs are not in a sufficiently advanced condition of development to support life. There are numerous instances, however, attested to both by the appearances of the children and the statements of the mother regarding the date of impregnation, where children of a less age than twenty-eight weeks have survived.[1]

Considerable difficulty has attended and always will attend the establishment of the exact date of impregnation, and as a consequence the same difficulty prevents us from determining the exact age of a child prematurely delivered (see Duration of Pregnancy).

"A very few exceptional cases have been recorded of the survival of children born a little over five months. An infant born earlier than this period could not be considered viable" (Reese).

Until recently it was generally believed that a child born as the result of a miscarriage at the end of the sixth month would almost of necessity die within a very short time of birth. Budin,[2] however, by means of Tarnier's *couveuse* and the operation of artificial feeding known as *gavage*, has lowered the mortality to a wonderful degree. By these means at the Maternité in Paris children have been saved—

At six months, . . .	30.0 per cent
At seven months, . . .	63.6 "
At eight months, . . .	85.7 "

"Of the children born at seven to eight and a half months, only 33 per cent are actually kept alive" (Winckel).

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[1] Ahlfeld : Arch. f. Gyn., viii., 194.

[2] La Semaine médicale.

To what Extent may the Normal Period of Utero-Gestation be Shortened, and Birth Notwithstanding be Given to a Living Child? (Viability.) In answer to this question, Tidy[1] states: "The question involves matters of grave importance, affecting not only the legitimacy of children but the honor of parents, and sometimes even the interests of nationalities.

"The earliest actual period at which a child is viable—that is, capable of extra-uterine life—must be determined by careful study not only of the cases generally reported but more particularly of those when no possible object was to be served by untruthfulness or confusion of facts; and such cases are admittedly very rare.

"In all questions of this nature, the two points requiring the special consideration of the medical jurist are as follows:

"1. Is a child of the age stated, or estimated, viable? That is, not whether it be mature or immature, nor whether it be diseased or healthful, nor whether it be likely or unlikely to be reared, but—was the child of such an age as to be capable of showing some indication of live birth after it was completely external to the mother?

"Such an inquiry will be of importance in cases of tenancy by courtesy. The question whether these like indications were exhibited before or after the separation of the cord, is for legal purposes immaterial.

"2. Granting it to be alive when born, is it probable that a child of the age stated or estimated could be reared?

"This question may be of importance in certain cases involving legal rights, as, *e.g.*, when a child is born shortly after marriage. In the tabular statement under the heading of Case 84[2] will be found the chief recorded cases where children have been born alive at early periods of utero-gestation. It may be here mentioned that the Parliament of Paris, in the case of Cardinal Richelieu, decided 'that an infant at five months possessed that capability of living to the ordinary period of human existence, which the law of France required for establishing its title to inheritance.'

"The Code Napoleon, however, mentions 180 days, or six calendar months, as the earliest period of utero-gestation when a child may be live-born. The Scotch law allows an infant to be viable at six lunar months, or 168 days. The practical conclusions to be drawn from the large number of recorded cases of abnormally shortened utero-gestation are as follows:

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[1] "Legal Medicine," New York, 1884, vol. iii., p. 31.

[2] Refers to illustrative case in Tidy's "Med. Jurisprudence."

"1. Allowing that from the first moment of impregnation the ovum is truly alive; and, further, that mere motion of the limbs, or evidence of circulation, without active respiration, are sufficient to constitute live birth, nevertheless there is no evidence to show that a fœtus, born at an earlier period than between the fourth and fifth months of uterine existence, can in any sense be said to be born alive, much less lead an independent life, *i.e.*, a life apart from its mother.

"2. That living children have been born between the fourth and fifth months of uterine life. As a rule, however, the only sign of life exhibited by children born at this early period is a slight motion of the limbs, although cases of somewhat more active vitality have been recorded. There is, however, no well-authenticated case where a less than five-months child has lived beyond twenty-four hours after its birth, and but one where it has lived for twenty-four hours.

"3. That children born alive at the fifth or between the fifth and sixth months of utero-gestation, mostly die after a few hours (Case 90).

"Nevertheless, there are a limited number of recorded cases, where such children have been reared and have even reached adult age (Case 84—13, 19, etc.). Thus in two out of the three illustrative cases recorded, in one the child born on the 174th day—calculated from the date of marriage—lived for seven months, the court deciding against the accusation of incontinency (Case 86), while in the second where the child reached maturity, there was an interval of 182 days only between its birth and the birth of the previous child (Case 88). In this latter case, assuming the prolific coitus to have taken place fourteen days after the first confinement, the uterine age of the child could not have exceeded 168 days. The question arises, however, whether the child may not have been a product of superfœtation (see Superfœtation). At any rate, this is not so in Case 86, where the time was estimated from the day of marriage, the good character of the parents being admitted by the court (Case 87).

"4. That several well-authenticated cases exist where children were born between the sixth and seventh months, and even at the sixth month have reached adult age, but that in such cases more than ordinary care and attention have been needed to maintain life, at least for some time after birth.

"Dr. Bonner ('A Critical Inquiry regarding Superfœtation, with Cases,' 1865) has collected eleven cases where children born about the 180th day of utero-gestation survived their birth for periods varying between eight days and fifteen years.

"5. That in all cases of early birth beyond the facts indicated by well-authenticated records, the question of the character of the parents, the conditions of the accouchement (such as its concealment and certain other general considerations) must of necessity constitute important evidence on which a jury should rely to decide the question of legitimacy.

"To the medical jurist the sound words of advice and warning of a learned obstetrician may not be out of place.

"'Take care not to be deceived. I have known many cases of fully developed and mature children being born within seven months of marriage. They are commonly regarded as marvels limited to first pregnancies. In all cases where legitimacy is contested on the ground of shortened utero-gestation there is one most pertinent question that the medical jurist will be called upon to answer and that is—Did the appearances presented by the child at birth correspond or not with its alleged shortened term of uterine life? It is unfortunate that, as a rule, discussions respecting the legitimacy of children occur after they are grown up, when it becomes necessary to rely for evidence on the memory of the accoucheur, or of the nurse in attendance, as to their condition and precise state of development at the time of birth. It is, however, certain—

"*a*. That although a child born at full time may vary in size, weight, and the like, nevertheless that it always has about it the general signs of what is called 'development:' that is, full maturity.

"*b*. Nevertheless, it must be admitted that it would be difficult, in the majority of cases, to decide with unerring precision whether a child at birth was an eight-months or nine-months child.

"*c*. It is, however, scarcely possible to suppose that a fully developed child could be mistaken for a seven-months child, it being a generally accepted fact, that the changes the fœtus undergoes during the last two months of uterine life are more marked than those occurring during any other period. Nevertheless, seeing that exceptional cases occur where children born at full term are enormously in excess of average size and weight, it is manifest that the medical jurist would scarcely be justified in pronouncing a positive opinion that a seven-months child might not be as well developed as an eight or nine months child under ordinary circumstances.

"*d.* That supposing a child be born mature and fully developed, and further supposing it provėd that to be the child of a husband it could not be more than a six-months child, the medical jurist need have no hesitation in pronouncing it illegitimate.

"Here then two questions suggest themselves:

"1. What are the signs of maturity in a new-born child? (See p. 284.)

"2. What are the indications whereby the development of the fœtus may be ascertained?" (See p. 291.)

LIVE BIRTH.

What Constitutes Live Birth ?—Sometimes it becomes necessary to establish the fact that the child when born was alive, independent of its viability, *i.e.*, capability of continuing to live. The question to be decided in such cases is not whether the child was mature, immature, or viable, but simply, **Was it alive?**

The test of a live birth differs in various countries.

In Germany[1] crying "attested by unimpeachable witnesses;" in France, respiration; in Scotland, crying. In England and the United States, "neither breathing nor crying are essential to establish a live birth; the pulsation of the child's heart, or of one of its arteries, or the slightest voluntary movement is regarded as sufficient for this purpose" (Reese).

In regard to crying as a test of live birth Coke remarks: "If it be born alive, it is sufficient, though it be not heard to cry, for peradventure it may be born dumb."

Legally all we require for a live birth is anything to prove that the child was alive at the time when it entered the world. Whether the child was viable or not does not enter into the definition.

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[1] Reese.

Two cases in particular are usually cited to show that fœtuses have been born alive before the completion of the fifth month of intra-uterine gestation and even as early as the end of the fourth month. One is that of Dr. Barrows of Hartford, and the other of Dr. Erbkam of Berlin.

In Dr. Barrows' case[1] a point of especial interest is the fact that the date of apparent impregnation was fixed.

This woman miscarried on the 18th of May. Following this miscarriage there was a profuse and prolonged lochial discharge. Upon the 18th of June there was a marked increase in the vaginal discharge, which was taken to be a menstrual period. This continued over a week and then entirely ceased. On June 27th the woman left her home to make a visit in the country, and then experienced sexual intercourse for the first time subsequent to her miscarriage. On the 18th of November, as a result of severe physical exertion, another miscarriage occurred, Dr. Barrows still being her attending physician. The ovum was expelled intact. The amount of liquor amnii was estimated to be about two pints.

"The membranes were not ruptured for some little time, during which the movements of the child were active and vigorous. On rupturing the membranes and exposing the child to the air, it instantly gasped, or, perhaps I ought rather to say, uttered a cry so loud as to be heard distinctly at a distance of several feet, it being at the same time covered with the bedclothes. The cord was tied on its ceasing to pulsate, at the end of two or three minutes, then separated, and the child wrapped in warm flannels. As it continued to manifest the ordinary appearances of life, its condition was watched with much interest and care. It breathed with a kind of convulsive gasp at intervals of one or two minutes, for a period of forty minutes. The heart beat regularly for forty-five minutes. . . . The child repeatedly opened its mouth, and thrust forward its tongue."

The fœtus, a female, measured ten inches, and the weight was fourteen ounces. In spite of the fact that the frontal and parietal bones were imperfect, the head was quite firm, and covered with a down-like hair. A firm skin covered the body, of a light color, with the exception of the abdomen, where it was reddish and thin. Rudimentary nails could be seen and the membrana pupillaris entirely closed the iris.

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[1] Amer. Jour. Med. Sciences, April, 1853, p. 380.

If we place the date of impregnation as corresponding with the date of the first cohabitation following the first-mentioned miscarriage, then we would have as the duration of the pregnancy and the age of the child 144 days, or less than five calendar months by six days.

Although the weight of this fœtus, fourteen ounces, is somewhat in excess of the average weight at the completion of five months of intra-uterine life, yet the length, which is of far greater value as a reliable sign of the duration of pregnancy, would indicate that the fœtus was not quite five months old. The remaining characteristics of the fœtus, as well as the date of the supposed conception as stated by the woman, all agree with the estimated 144 days as the length of gestation.

In Dr. Erbkam's[1] case the fœtus measured six inches in length and weighed eight ounces. It was born alive and lived half an hour; it moved its extremities, turned its head from side to side, and opened its mouth. Müller, who saw this fœtus, stated that it was not more than four months old.

THE CHARACTERISTICS OF THE FULLY DEVELOPED (FULL-TERM, MATURE) CHILD.

1. **Length.**—According to Winckel and others, the length of the child is the most reliable test of time the fœtus has remained within the uterus. Second in importance stands the weight, and third the diameters of the head.

The following table is taken from Quetelet's "Anthropométrie" (Brussels, 1870), and gives the average lengths of a large number of Belgians, which are probably somewhat less than the average for a corresponding number of English would be:

LENGTH OF THE NEW-BORN CHILD.

	MALES.	FEMALES.
Maximum.......	20.97 in. 53.3 centimetres.	21.87 in. 55.4 centimetres.
Average.........	19.72 " 50.1 "	19.34 " 49.1 "
Minimum.... ...	17.24 " 43.8 "	17.24 " 43.8 "

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[1] Amer. Jour. Med. Sciences, 1838, p. 244.

Winckel[1] from observations of several thousand cases gives the following figures:

Maximum = 21.80 inches = 55.4 centimetres
Average = 20.00 " = 50.8 "
Minimum = 19.20 " = 48.8 "

The following table is taken from Tidy:[2]

Average length of 247 mature children (both sexes) = $18\frac{4}{5}$ in.
" " 130 " " (males) = $19\frac{5}{8}$ "
" " 117 " " (females) = $18\frac{5}{8}$ "
Maximum = 22 inches.
Minimum = 16 inches.

Dr. Delahost, of Rouen, says that the length of the fœtus for the first six months is indicated in centimetres by the square of the number of the corresponding month. That at one month the fœtus measures one centimetre, at two months four centimetres, and so on. During the last three months the monthly rate of growth is four or five centimetres.

Taylor gives 16 to 21 inches for the average length.

Tardieu's averages are 18 to 20 inches.

Lusk gives the average length as from 20 to 21 inches.

2. **Weight.**—It must be borne in mind that the weight of the child is dependent upon race, sex, stature of parents, and perhaps to a certain extent upon the age of the mother.

AVERAGE WEIGHT.

Hecker,[3] in Munich (1,000 births), $6\frac{4}{5}$ lbs. average.

Fesser,[4] in Breslau, $6\frac{1}{2}$ lbs. average.

Ingerslev,[5] in Copenhagen (3,450 births), about 7 lbs. average.

Scanzoni[6] in Vienna (9,000 births), about 7 lbs.

Besides giving the above figures, Lusk[7] states his own observations upon 200 children born in the Bellevue Hospital. For these the average was $7\frac{3}{4}$ lbs. for both sexes. The boys averaged $7\frac{9}{10}$ lbs. and the girls $7\frac{1}{3}$ lbs.

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[1] "Text-book of Midwifery," 1890. p. 51.

[2] "Legal Medicine," vol. iii., p. 33. Wm. Wood & Co., New York.

[3] "Klinik der Geburtskunde," ii., 1864.

[4] Spiegelberg, "Lehrbuch," p. 86.

[5] Obstet. Journ., iii., 1876, p. 705.

[6] "Lehrbuch der Geburtshülfe," p. 96.

[7] "Science and Art of Midwifery," New York, 1892.

"Three-fourths of the mothers were of Irish birth, one-fifth were born in America, while the remaining fraction was divided between English, Scotch, and Germans. The largest child weighed eleven pounds."

Quetelet also gives the average weight at birth as 6.8 lbs. for boys, and 6.6 lbs. for girls; Taylor, 5 to 9 lbs. for the average weight of mature children; Tardieu, 6 to 7 lbs.

Of 4,104 infants born at the Maternité, Madame Alliott found that 2,142 weighed between 6.6 and 7.7 lbs. (Tidy).

Winckel's figures for the weight of the fully developed child are 5.3 lbs. for the minimum and 10.5 lbs. for the maximum. Of 3,000 children born in Munich, he states, from 1884 to 1886, only 46 or 2.3 per cent weighed 7.8 lbs. or more, and none weighed over 9.7 lbs.

Pinard, from an examination of the records of the Paris University, found that but one in 20,000 cases weighed a trifle over twelve pounds.

Dr. R. P. Harris, in a note of Playfair's "Midwifery," states: "We have had children born in this city, Philadelphia, at maturity that weighed but one pound. The well-remembered 'Pincus' baby weighed a pound and an ounce."

"Probably the largest fœtus on record was that of Mrs. Captain Bates, the Nova Scotia giantess, a woman 7 feet 7 inches in height. This child, born in Ohio, was their second, and was lost in its birth, as no forceps of sufficient size to grasp the head could be procured. The fœtus weighed twenty-eight and three-fourths pounds, and was thirty-nine inches in length. Their first infant weighed nineteen pounds."

There is a popular belief that long and heavy children have been retained in the uterus longer than usual.

As a general rule, still-born children are heavier and longer than those born alive, males than females, single children (*cæteris paribus*) than twins, and twins than triplets (Tidy).

In 500 male and 500 female children, taken from the records of the Philadelphia Hospital, the average weight at birth of the female was seven pounds one ounce and a half, and of the male seven pounds eight ounces. In only one of a thousand was the weight eleven pounds (Parvin).[1]

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[1] "A curious fact which I observed in my hospital service is, that there is less difference in weight between the sexes of the new-born in the

3. **Diameters of the Fœtal Head and Body at Term.**—Lusk[1] bases his table of measurements upon that given by Tarnier and Chantreuil, and gives the following figures:

DIAMETERS OF THE FŒTAL HEAD.

Occipito-mental diameter, 5¼ inches.
Occipito-frontal diameter, 4½ inches.
Suboccipito-bregmatic diameter, 3¾ inches.
Biparietal diameter, 3¾ inches.
Bitemporal diameter, 3¼ inches.
Bimastoid diameter, 3 inches.
Fronto-mental diameter, 3¼ inches.
Cervico-bregmatic diameter, 3¾ inches.
Great circumference (occipito-mental), 14¾ inches.
Small circumference (suboccipito-bregmatic), 13 inches.

Spiegelberg[2] gives the breadth of the shoulders, the bis-acromial diameter, as about 4¾ inches, and the circumference corresponding to this diameter as 13½ inches. He further gives the dorso-sternal diameter as from 3½ to 3¾ inches, and the bis-iliac 3¾ to 4 inches.

4. **The Color of the Skin.**—In the mature child the color of the skin is pale red, much paler than in the case of the immature child, where we see a deep or dark red color more often.

5. **Hair upon the Head.**—The hair is generally thick, and from one to two inches in length (Winckel).

6. **Immobility of the Cranial Bones.**—The sutures and fontanelles should be narrow, and the length of the anterior fontanelle should be from three-fourths to one inch in length, and the cranial bones are not especially movable (Casper). The bones of the head are hard and their margins lie close to one another (narrow sutures).[3]

7. **Lanugo — Vernix Caseosa — Sebaceous Cysts.** — Lanugo, or the fine short down, which almost entirely covers the surface of the immature child, disappears to a great extent

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black than in the white. While a sufficient number of observations have not been made to establish a law, there are *a priori* reasons for believing in the possibility of such a law" (Parvin: "Science and Art of Obstetrics," Phila., 1886, p. 138, note).

[1] "Science and Art of Midwifery," New York, 1892.

[2] Spiegelberg: "Lehrbuch der Geburts.," 1891, p. 97.

[3] *Ibid.*, 1891.

as maturity approaches and is only seen upon the neck, shoulders, and back.

Vernix caseosa is usually found in the folds of the thigh, back, and axilla, but may be extensive in amount.

The statement is made, that certain white spots, found in many cases on the cheeks, forehead, alæ of the nose, and especially upon the chin and lower lip, and which are said to be formed by the dilatation of the excretory ducts of the sebaceous follicles, are abundant in proportion to the immaturity of the fœtus, decreasing in number as full term approaches. At full term they are only to be found on the tip of the nose (Küstner).[1]

MECONIUM.[2]—At full term meconium, which consists of intestinal mucus and epithelia, swallowed liquor amnii (epithelial shreds, lanugo, and vernix caseosa), and which is of a dark color, owing to the presence of cholesterin and bilirubin crystals, is now only found in the rectum.

8. **Conditions of the Nails.**—On the fingers they should extend beyond the tips; on the toes only as far as the end.

9. **Position of the Umbilical Cord.**—Many authorities state that the insertion of the cord is in the centre of the body in a mature child. Tidy[3] states that "the exceptions to this rule are . . . so numerous as to deprive it of any forensic value as a sign of maturity." Winckel[4] places it one to one and a quarter inch under the exact middle point of the body. Spiegelberg[5] puts it just below the middle of the long axis of the body, and quotes Hecker as stating that even at the sixth or seventh month the distance from the symphysis to the ring is to that from the ring to the ensiform cartilage as 1:1.6.

10. **Condition of the Genitals.**—They should be fully developed. In the mature male the testicles are usually[6] present in the scrotum, which is markedly corrugated and brownish; the canal is still open, however.

In the mature female the labia majora touch one another and usually, but not always, completely cover the labia minora,[7] ostium vaginæ, and clitoris. The latter is no longer prominent as in immature children. Exceptions to the foregoing are not uncommon.

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[1] See London Med. Rec., November 15th, 1870, p. 461, and Arch. f. Gynäk., Berlin, 1877, xii., 102–113.

[2] Zweifel: Arch. f. Gyn., vii., p. 474. Spiegelberg: "Lehrbuch der Geburts.," 1891, p. 97.

[3] "Legal Medicine," Wm. Wood & Co., New York, vol. iii., p. 36.

[4] "Text-book of Midwifery," 1890.

[5] Spiegelberg: "Lehrbuch der Geburtshilfe," 1891.

[6] Tidy found but one testicle at birth in three or four per cent.

[7] Spiegelberg: "Lehrbuch der Geburtsh.," 1891, p. 197.

11. **Condition of the Cartilages of the Ears and Nose.**—In mature children the cartilages of the ears and nose should be distinctly perceptible.

12. **The Centre of Ossification in the Lower Epiphysis of the Femur.**—This test, of course, can only be applied where the child is dead. At one time it was held "that, in the second half of the tenth (lunar) month, the centre of ossification of the inferior femoral epiphysis makes its appearance" (Béclard, Ollivier, Wildner).[1]

The centre of ossification in the lower epiphysis of the femur is usually one-fifth of an inch in size in the mature fœtus; "but may attain to this at an earlier period, and may also be wanting or very little developed at birth" (Caspar, Béclard, Hecker, Hartmann).[2] (Plate IV, Fig. 7.)

Spiegelberg[3] states that the bone nucleus in the lower epiphysis of the femur is about one-fifth of an inch long at full term, but that it may be much smaller or even be absent.

Tidy[4] gives the following directions for finding the centre of ossification: "To find this centre of ossification, a horizontal incision is to be made through the skin and superficial tissues over the knee-joint down to the cartilages. After removing the patella, the end of the femur is to be made to protrude. Horizontal sections are now to be carefully sliced off from the cartilaginous epiphysis, layer by layer, until a colored point is observed, the greatest diameter of which osseous nucleus is to be measured. This nucleus appears to the naked eye as a more or less circular blood-red spot in the midst of milk-white cartilage, in which vascular convolutions may be distinctly recognized."

In Caspar's observations upon this osseous nucleus the results were as follows:

	Number of Children Observed.	Size of Nucleus.
In the 7th and 8th month....	31	0
In the 9th and 8th month....	9	0–2 lines.
In mature children..........	52	$\frac{1}{4}$–4 "

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[1] Tidy.

[2] Winckel.

[3] Spiegelberg: "Lehrbuch der Geburtsh.," 1891, p. 51.

[4] "Legal Medicine," W. Wood & Co., 1884, vol. iii., p. 36.

Ollivier d'Angers measured the nucleus in the case of fifty infants varying in age from a few hours to one year, and his results were as follows:

At term from $\frac{1}{25}$ to $\frac{2}{25}$ × $\frac{1}{6}$ or $\frac{1}{5}$ of an inch.
13 to 20 days, $\frac{1}{4}$ × $\frac{1}{5}$ of an inch.
Above 20 days, $\frac{7}{25}$ × $\frac{1}{5}$ of an inch.
Above 8 months, $\frac{1}{2}$ × $\frac{1}{5}$ of an inch.
Above 9 months, $\frac{3}{5}$ × $\frac{1}{2}$ of an inch.
Above 11 months, $\frac{3}{5}$ × $\frac{13}{25}$ of an inch.

Tidy[1] sums up the facts observed by himself and others as follows:

"(1) If there be no visible trace of this osseous nucleus the fœtus cannot be more than from 36 to 37 weeks old.

"(2) If it be the size of a hempseed, or the head of an ordinary fly (*i.e.*, about half a line), it corresponds to 37 or 38 weeks, if still-born.

"(3) When from $\frac{3}{4}$ to 3 lines, it indicates a uterine age of about 40 weeks.

"(4) If it measures more than 3 lines, the child has probably survived its birth."

General Characteristics of the Mature Child.—"All the parts are properly rounded off and supplied with a bountiful cushion of fat. The skin has lost the deep red color, and is covered with vernix caseosa only on the dorsal and in the flexor surfaces of the extremities. Lanugo has also disappeared; the hair is usually dark and about one and a quarter inches long; the head is still the most spacious part of the body, and the skull in particular exceeds in size the face, which latter, however, has a marked full roundness. . . . Ear and nasal cartilages are hard to the touch; eyebrows and lashes are distinctly developed; the thorax appears rounded, the breasts are in both sexes relatively strongly developed, and contain some secretion.

"Fully developed children look about in a lively manner; they move their extremities vigorously and cry aloud; they evacuate urine and intestinal contents soon after birth, make attempts at nursing, and eagerly and strongly seize the offered mammæ. Deviations from the . . . average are frequent" (Spiegelberg).

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[1] Legal Medicine," vol. iii., p. 37.

THE CHARACTERISTICS OF THE EMBRYO AND FŒTUS DURING THE SEVERAL MONTHS OF GESTATION.

The following description has been taken from the last edition (1891) of Spiegelberg-Wiener's "Text-book of Midwifery."

At the end of the **first month** the embryo, according to His, has a length of from $\frac{7}{25}$ to $\frac{3}{10}$ inch and is markedly curved upon itself, the head and breech being nearly in contact. The head is almost at a right angle to the neck. The divisions of the brain can be recognized on the head; the mid-brain projects most markedly forward. The eye is relatively small, and the lens is nearly closed. The nose appears as an extensive oval area surrounded by thick margins. The pharyngeal arches are broad strips extending up to the cerebral hemispheres. Both extremities are broad flaps which are slightly constricted at their junction with the body, and are without distinct articulations. In the space within the somatopleure, visible from without, lie the heart, the liver, and the starting-point of the thick, short, abdominal pedicle. The umbilical vesicle is already pedicled. The umbilical cord proceeds to the right of the abdominal pedicle from the body, while the blunt caudal extremity of the body usually lies at the left of it. Of the youngest known ova, that of Reichert was expelled fourteen days, that of Breus ten days, and the first one of Thomson fourteen days after the cessation of menstruation. Concerning the age and phase of development of young human embryos His establishes the following scale:

Embryos of	2 to $2\frac{1}{2}$	weeks,	$\frac{1}{12}$ to $\frac{1}{5}$ inch.
"	$2\frac{1}{2}$ to 3	"	$\frac{1}{8}$ to $\frac{1}{6}$ inch.
"	$3\frac{1}{2}$	"	$\frac{1}{5}$ to $\frac{1}{4}$ inch.
"	4	"	$\frac{7}{25}$ to $\frac{1}{3}$ inch.
"	$4\frac{1}{2}$	"	$\frac{2}{5}$ to $\frac{11}{25}$ inch.
"	5	"	$\frac{1}{2}$ inch.

Arranged according to the size of the chorion, there exists the following scale (His):

Chorion	under	$\frac{3}{5}$ inch,	embryo	between	$\frac{1}{12}$ to $\frac{1}{6}$ inch.
"	from	$\frac{3}{5}$ to $1\frac{1}{5}$ in.	"	"	$\frac{1}{6}$ to $\frac{2}{5}$ "
"	"	1 to $1\frac{3}{5}$ "	"	"	$\frac{2}{5}$ to $\frac{3}{5}$ "
"	"	$1\frac{2}{5}$ to 2 "	"	"	$\frac{3}{5}$ to $\frac{4}{5}$ "
"	"	$1\frac{3}{5}$ to $2\frac{2}{5}$ "	"	"	$\frac{4}{5}$ to 1 "

At the beginning of the **second month** the embryo, according to His, measures ⅓ to ⅜ inch, and at the end of the month, ⅞ to 1 inch. The definite transition from embryo to fœtus takes place during the stages of development from ⅗ to ⅔ inch. The head rises pretty rapidly so that the mid-brain projects more and more beyond the cervical eminence. The external configuration at the head and trunk is more and more uniformly rounded off, the superior maxillary process coalesces definitely with the lateral portion of the nose, and the last transitory furrows and fissures of the body surface disappear. The lips become more distinct at the oral fissure, and the auricles at the ear openings. The several parts of the extremities increase in length, and at the foot the toes begin to be differentiated. In embryos of ⅔ inch up to the end of the second month the back is straightened so far that a vertical line from the vertex strikes the body close behind the coccyx which still projects anteriorly below the external sexual and anal region. Brain and liver enlarge considerably, especially the former, so that at the end of this period the head exceeds the trunk in size. The first rudiments of the lids develop around the eyes in the shape of low folds, the auricle becomes more distinct, the extremities project more in front, and extend considerably beyond the trunk at the end of the period. The finer articulation of the extremities has already advanced greatly.

Toward the end of the **third month** the ovum is 3⅗ to 4⅖ inches long; the chorion has lost a great part of its villi, and the placenta is formed, though still very small. The funis has become much longer and twisted; it is inserted very near the lower end of the trunk. The intestine is withdrawn from the umbilical aperture. The embryo measures 3 to 3½ inches and weighs about one ounce. The neck now separates the head from the trunk; the latter, by the development of the ribs, is distinctly divided into chest and abdomen. Oral and nasal cavities are separated by the palate; the lips close the mouth; rudimentary teeth begin to develop in the maxillæ. Points of ossification have formed in most of the bones; fingers, toes, and traces of the nails may be observed on the extremities. Scrotum and labia develop, but penis and clitoris are still of equal length.

Toward the end of the **fourth month** the placenta is thicker and larger, the funis more twisted and thicker. The fœtus is

4 to 7 inches long, weighs on an average 2 ounces; the length of the head is one-fourth that of the body. The cranial bones are partly ossified, but show very wide sutures and fontanelles. The face is quite distinct; mouth, nose, eyes, and ears have their proper shape. The sex can be distinguished; the skin is firmer; hair begins to develop. The fœtus commences to make occasional though slight movements with its limbs.

A fœtus of the **fifth month** is 7¼ to 10¾ inches long and weighs nearly 9 ounces, but the liquor amnii exceeds it in weight. The head is relatively still very large, the face has a senile appearance. The eyelids begin to separate. Lanugo is distinctly present, mainly at the place of the eyebrows and on the forehead. The skin is richer in fat and, therefore, more resistant; its surface is coated, though still sparsely, with vernix caseosa—a white fatty substance consisting of epidermal scales, lanugo, and sebum. The mother feels "quickening." Fœtuses born toward the end of the fifth month sometimes breathe for a short while and move their limbs.

Toward the end of the **sixth month** the fœtus measures 11 to 13½ inches and weighs about 22 ounces. The head is relatively still very large. The upper part of the chest looks more arched, owing to advanced development of the pectorales; the gluteal muscles are more strongly developed; the entire trunk is fuller. The insertion of the funis is higher up, in the middle third between symphysis and ensiform process. The lids have separated; lashes and eyebrows are more prominent; the hair of the head is longer and gradually loses the character of lanugo. The testicles approach the inguinal rings. Bile-stained contents in the intestines, sometimes also meconium in the upper part of the large intestine. A fœtus born at this time moves and makes faint efforts at inspiration, which, however, soon cease.

Seventh Month.—Length of fœtus, 14 to 15 inches; average weight, 38 oz. The head, still very large, is firmer; the extremities are rounding off; but the skin is still greatly wrinkled. A testicle is often found at the external inguinal ring. At the beginning of the seventh month the whole body is covered with hair, most thickly on the forehead, cheeks, around the mouth, and at the nucha. On the trunk the hair is close but shorter, while on the extremities it is sparse and partly absent. The larger part of the rectum contains meconium. The pupillary membrane has nearly always disappeared by the end of the month. Fœtuses born alive between the 24th and 28th weeks perish, as a rule, very soon.

Eighth Month.—Length, 15½ to 16½ inches; weight, 50½ oz. Funis inserted ⅗ to 1⅕ inch above the middle of the line from the ensiform process to the symphysis. The hair of the scalp is denser, the lanugo is beginning to disappear from the face. The nails have become harder, but do not yet reach to the finger-tips. A testicle is usually found in the scrotum. At the end of the eighth month ossification begins in the lower epiphysis of the femur. A fœtus born about this time may be kept alive with some care.

Ninth Month.—Length, 17 to 17¾ inches; weight, 62½ oz. The body is more rounded in form by the greater development of fat; the face is relatively larger and more pleasant; the formerly numerous milia around the mouth and on the cheeks gradually disappear. The cranial bones are still quite flexible, the nails not yet fully developed. There is more hair on the scalp and less lanugo. Children of this period approach the mature ones in their vital activities, but they are much less energetic, mostly somnolent, and they usually perish unless carefully nursed

Tenth Month.—In the first weeks the fœtus measures 18 to 19 inches and weighs 75 oz. It gradually assumes the characteristics of the full-term child and possesses them in the last two weeks.

The measurements and weights given are Hecker's; those obtained by Ahlfeld are greater.

In estimating the age we should consider both the general development and that of special parts. The weight is less reliable than the length.

The length, at the beginning of the fifth week (measured from the parietal curvature along the middle line of the back down to the coccyx), amounts to ⅗ inch and increases ⅕ inch every following week, so that at the end of the eighth week it reaches 1⅗ inches.

The length of the extended body (from vertex to heel) is 2⅘ inches at the end of the third month, 4¾ inches at the end of the fourth month, 8 inches at the end of the fifth month, 12 inches at the end of the sixth month, 14 inches at the end of the seventh month, 16 inches at the end of the eighth month, 18 inches at the end of the ninth month, and 20 inches at the end of the tenth month; thus increasing by two inches each month from the end of the sixth month.

The most available criteria afforded by single parts are: the development of the hair, the appearance and size of individual centres of ossification, and the degree of development of certain portions of the brain. A centre of ossification appears in the calcaneum at the beginning of the seventh month and may reach $\frac{1}{5}$ inch in diameter; it grows in length until, at the end of the eighth month, it measures $\frac{1}{6}$ to $\frac{7}{25}$ inch; at the end of the ninth month $\frac{1}{4}$ to $\frac{2}{5}$ inch; at the end of the tenth month, $\frac{3}{8}$ to $\frac{1}{2}$ inch. Ossification commences in the astragalus at the beginning of the eighth month. The ellipsoid nucleus measures at the end of the eighth month $\frac{1}{12}$ to $\frac{1}{5}$ inch; at the end of the ninth month, $\frac{1}{5}$ to $\frac{1}{4}$ inch; and at term, $\frac{7}{25}$ to $\frac{3}{8}$ inch. The centre of ossification in the lower epiphsyis of the femur, as a rule, does not appear before the ninth month.

The centres of ossification in the upper epiphysis of the tibia, and in rare cases in the upper epiphysis of the humerus, show themselves toward the end of the tenth month; if they are present, one may safely assume that the fœtus is fully developed. Their absence, however, does not necessarily indicate immaturity.

Of importance in the estimation of the age of the fœtus is, finally, the appearance of the surface of the brain, particularly the region of the fissure of Sylvius, whose development corresponds to certain periods of time. In the seventh month it is still a wide, nearly triangular pit; it contracts and deepens in the eighth month; while in the ninth month the parts surrounding the fissure (the frontal and temporal lobes) approach each other more and more, so that the fissure is completely developed at the end of the month. Furthermore, while in the ninth month only the main fissures and convolutions are developed, at the end of the ninth or beginning of the tenth month numerous secondary or accessory fissures appear, and the whole brain is strikingly richer in convolutions.

See ABORTION, Vol. II., pp. 105–107.

THE FULLY DEVELOPED FŒTUS.

According to Spiegelberg's measurements, it is on an average 20½ inches long and weighs 6 lbs. 14½ oz. The breadth of the shoulders, the bis-acromial diameter, is about 4¾ inches, and their circumference about 13½ inches; the dorso-sternal diameter is 3½ to 3¾ inches; the bis-iliac, 3¾ to 4 inches (see p. 287).

The umbilical cord is inserted just below the middle of the long axis of the body (even from the sixth to the seventh month its point of insertion in the abdomen is unchanged; its distance from the symphysis is to its distance from the ensiform process as 1 : 1.6—Hecker).

Meconium,[1] consisting of thickened intestinal mucus, of intestinal epithelia, swallowed liquor amnii (epithelial shreds, lanugo, and vernix), of a deep dark color, owing to the presence of bile (cholesterin and bilirubin crystals), is now only to be found in the rectum.

The centre of ossification in the lower epiphysis of the femur is about ⅙ inch long, but it may also be much smaller or even absent.

The heaviest fœtus which Spiegelberg found in his clinic weighed 11 lbs. 7½ oz. and measured 23 inches. (In private practice Spiegelberg extracted a child of 13 lbs. 3½ oz. and 22¾ in length.) In general, the length increases with the weight, but by no means proportionately.

The physical development of the fœtus is influenced by (1) its sex; boys being on an average longer and heavier than girls. (2) The number of pregnancies. Children of primiparæ weigh on an average 4¼ oz. less than those of multiparæ, though their length differs little. (3) The age of the mother. The weight generally increases up to the thirty-ninth year. (4) The constitution and vigor of the parents. It is a matter of course that the nutrition of the maternal body is important to the development of the child's body, and tall women, according to Fasbender's numerous measurements, bear heavier and longer children.

In proportion to the head, the trunk is generally more strongly developed in girls; this greater development concerns the transverse direction alone and is based on a larger quantity of the panniculus adiposus. Thus even at birth the contrast between female and male body is marked.

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[1] Zweifel: Arch. f. Gyn., vii., p. 474.

Proportion of births: 100 girls to 106 boys (according to Veit, 100:105.88 in Prussia).

ILLUSTRATIVE CASES OF EARLY VIABILITY.

1. *Parvin:* "*Science and Art of Obstetrics,*" *Phila.*, 1886, *p.* 139. —"In one instance in my practice a child was born weighing only one pound and a half, the pregnancy ending a few days before the completion of the seventh month; the child lived, and is now a healthy boy of seven years."

2. *Kolowko, A.: Centralbl. f. Gynäk., Leipzig*, 1890, *xiv.*, 235–237.—On the question of the viability of very small and immature children, a case cited was one where the last menstruation occurred in April, and the child was born October 5th, making the duration of pregnancy about twenty-seven weeks. The child lived and increased rapidly in weight.

3. *Stevens, E. B.: Obstet. Gaz., Cincin.*, 1882, *v.*, 568–571.—Viability of the premature fœtus.

4. *Routh, C. F. H.: Trans. Obst. Soc., London*, 1871, *xiii.*, 132.—Case of viability in a child born at five and a half months.

5. *Madden, T. M.: Obst. Jour. Gr. Brit., London*, 1873–74, *i.*, 80–89.—On the early viability of the fœtus in premature deliveries.

6. *Tidy, C. M.:* "*Legal Medicine,*" *W. Wood & Co., New York, vol. iii., pp.* 54–56.—Cases of early viability. Here will be found the record of forty-eight cases with the period of utero-gestation ranging from four to six months, together with the references and remarks upon the appearance, weight of the child, etc.

7. *Githens: Amer. Jour. Obst., New York*, 1876, *ix.*, 666.—Viability of a six-months' fœtus.

8. *Hubbard, C. J.: N. Y. Med. Jour.*, 1890, *li.*, 491.—The birth of a very small living child (18 oz.). Length, 10 in.; head, 3 in. in length and 8 in. in circumference around the ears; thighs, 2½ in. in circumference; finger-nails perfect; emaciated; lived eight hours. Mother considered herself pregnant seven and a half months.

9. *Maison: Soc. de Méd. lég. de France, Bull. Paris*, 1881–82, *vii.*, 146–150.—Note sur la viabilité des nouveau-nés.

10. *Moore, J. H.: Med. and Surg. Reporter, Phila.*, 1880, *xlii.*, 351.—A case of early viability.

11. *Polaillon: Ann. d'Hyg., Paris*, 1877, *xlvii.*, 535–546.—Rapport sur un cas de viabilité.

12. For recent literature upon the early viability of the child see the following references:

Gilbert, A.: Zeitschr. f. Geburtsh. u. Gyn., Stuttgart, 1888, *xvi.*, 53–56.

Charpentier et Butte: Compt. rend. Soc. de Biol., Paris, 1889, *i.*, 652–655. (*Nouv. Arch. d'Obst. et de Gyn., Paris*, 1889, *iv.*, 545–550.)

Von Brehm, H.: St. Petersburg med. Wochenschr., 1890, F. *vii.*, 77.

Bailly: Arch. de Tocol., Paris, 1879, *vi.*, 756–761.

Cullingworth, C. J.: Obst. Jour. Gr. Brit., London, 1878–79, *vi.*, 163–168.—Case illustrating the viability of extremely small premature children; with brief reference to several analogous examples.

Fochier, A.: Mém. et Compt. rend. Soc. d. Sc. Méd. de Lyon (1877), 1878, *xvii.*, 2 *prt.*, 28–36. *Lyon Méd.*, 1877, *xxiv.*, 441–446.—Note sur l'appréciation de la viabilité en médecine légal.

III. RESEMBLANCES—MOTHER'S MARKS.

The medico-legal importance of resemblances, physical and mental, concerns questions of paternity in bastardy cases, and in instances where a child substituted for another claims to be the heir to an estate.

Again, a woman shortly after the death of a first husband marries a second. Within ten or perhaps eleven months later, a child is born, and the question of paternity arises.

In such cases **likeness to the parent** is rightfully held as an important proof of paternity.

Most works upon medical jurisprudence cite an instance which occurred in Appenzell in Switzerland. In a bastardy case, the question arose which of two men, both of whom had had connection with the woman within seventeen days, should be held to be the father of the child in question. The court postponed the case, in order that the likeness to the father might develop itself.

Tidy[1] says: "The evidence in these cases must be chiefly circumstantial. Access being proved, the following questions arise: (*a*) Is the period intervening between the time when access was possible and birth (supposing the child to be mature) the normal period of utero-gestation? (*b*) If the period be protracted beyond 280 days, is it within the possible range of protraction, as laid down by authorities and proved by cases? (*c*) If the period be short duration, does the appearance of the child correspond with its asserted uterine age, and is the period one within which, according to authorities and recorded cases, a living child might possibly be born? (*d*) If the child be immature, what is its probable age?"

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[1] "Med. Jur."

Deformities, as is well known, may be transmitted from parent to offspring. In deciding a case upon such evidence we are met with the fact that certain authorities believe that it is quite possible for the mind of the pregnant woman to be influenced by the mere sight of the deformity in the person of the alleged father of her child, and that this impression has affected the child.[1]

Again, it must be remembered that **color** may be transmitted and may serve as important evidence.

Associated with the medico-legal question of resemblances and parentage is the **effect of former impregnation.** There seems to be abundant proof that in cases where a woman marries a second time, her children may resemble neither parent but the first husband.[2]

And then, finally, it must be borne in mind, that while it is the rule for children to resemble their parents or ancestors,[3] yet there are exceptions where absolutely no likeness is present.

"Children may or may not resemble their parents in the color of the skin, hair, eyes; in certain anatomical conditions and peculiarities, as hypospadias, transposition of viscera, etc.; in power of procreation; in longevity; in peculiarities of voice, gait, and gesture, and in the predisposition to certain diseases. In other words, the absence of likeness, of transmitted defects, and of other peculiarities, neither disproves paternity nor proves legitimacy" (Tidy).

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[1] See Reese: "Med. Jurisp.," Phila., 1889, p. 543.

[2] "It is known to breeders of horses and cattle, that the influence of the impregnation by one sire may be extended beyond the foal begotten at the time, and affect those begotten subsequently by another sire. This is proven by the later colts, or calves, bearing the peculiar markings of the first sire. The question, therefore, might be suggested whether the same *handing down* of parental likeness to the children of a subsequent father might be possible. Without any positive data on which to venture an opinion, it may, nevertheless, be suggested here as a circumstance to be considered in certain cases of affiliation" (Reese).

[3] "The fact that a child may bear a more striking likeness to its grandparents or to other relations, or what is more astonishing, to some very remote ancestor, is well known" (Tidy).

ILLUSTRATIVE CASES OF RESEMBLANCES AND MOTHER'S MARKS.

1. *Stothard v. Aldridge* (Bail Court, Jan., 1856) (Quoted by Tidy).—The plaintiff sues the defendant for damages for the seduction of his wife. Defendant was a man of color. The child born of the alleged adulterous intercourse was proved by the medical witness to have been born colored, and to have had woolly hair. The husband and wife were both light. The complexion of the child fixed the paternity on the black defendant.

2. *Parsons: Phil. Trans., vol. lv.* (Quoted by Tidy).—(1) A black man marries a white woman. A daughter is born resembling the mother in features and color, except that the right buttock and thigh were black. (2) Another case was that of a black man who married an Englishwoman. The child born as the result of the marriage was quite black. (3) A third case reported by the same author was that of two black parents having a white child. The mother was fearful her husband would suspect her of unchastity. The father stated that his own father was a white man and further said: "My grandfather and grandmother were both as black as you and myself; and although we came from a place where no white people were ever seen, yet there was always a white child in every family belonging to us."

3. *Douglas Peerage Case*, 1767-69.—Lord Mansfield, in delivering the judgment to the House of Lords, expressed a very decided opinion in favor of the parental likeness which the claimant bore to his father, as constituting an important link in the chain of evidence. (See "Collectanea Juridica," London, 1792, Vol. II., p. 386. Also Beck, Tidy, Taylor, Wharton, and Stillé, and Reese upon Medical Jurisprudence. "American and English Encyclopædia of Law," 1891, Vol. XV., p. 215.)

Lady Jane Douglas was married August 10th, 1746, to Colonel Stewart. She became pregnant, and the fact was notorious in January, 1748. On the 10th of July, 1748, being in her fiftieth year, she was delivered of twins in Paris. Of these, one (Sholto) did not live to manhood, but the other (Archibald) did. Lady Jane, after their birth, had a miscarriage. In progress of time both father and mother died. Their positive declarations had convinced the Duke of Douglas, and he left his dukedom and other estates to his nephew and their son Archibald, who was the appellant in the case.

The Duke of Hamilton opposed the claim on the ground that they were supposititious children.

The case came up for final adjudication in the House of Lords in 1769, when Lord Chancellor Camden and Lord Chief Justice Mansfield decided in favor of the appellant.

The following extracts from the decision of Lord Mansfield are interesting, both as to the age at which pregnancy is possible and probable and as to the resemblances of children to their parents:

"Lady Jane became pregnant in October, 1747, at the age of forty-nine years—a thing far from uncommon, as is attested by physicians of the first rank, and confirmed by daily experience. It is further proved that the elder child, the appellant, was the exact picture of his father, and the child Sholto as like Lady Jane as ever child was like a mother. I have always considered likeness as an argument of a child's being the son of a parent, and the rather as the distinction between individuals in the human species is more discernible than in other animals. A man may survey ten thousand people before he sees two faces perfectly alike, and in an army of a hundred thousand men every one may be known from another.

"If there should be a likeness of features there may be a discriminancy of voice, a difference in the gesture, smile, and various other things, whereas a family likeness runs generally through all these, for in everything there is a resemblance, as of features, size, attitude, and action. And here it is a question whether the appellant most resembled his father (Sir John), or the younger Sholto resembled his mother.

"Many witnesses have sworn to Mr. Douglas being of the same form and make of body as his father; he has been known to be the son of Colonel Stewart by persons who have never seen him before, and is so like the elder brother, the present Sir John Stewart, that except by their age it would be hard to distinguish one from the other.

If Sir John Stewart, the most artless of mankind, was actor in the *enlèvement* of Mignon and Saury's children, he did in a few days what the acutest genius could not accomplish for years. He found children, the one the finished model of himself, and the other the exact picture, in miniature, of Lady Jane.

"It seems Nature had implanted in the children what is not in the parents, for it appears in proof that in size, complexion, stature, color of the hair and eyes, nay, and in every other thing, Mignon and his wife, and Saurry and his spouse, were *toto cœlo* different from and unlike to Sir John Stewart and Lady Jane Douglas."

The House of Lords decided in favor of the appellant, only five peers dissenting.

"The Amer. and Eng. Encyclopædia of Law," Northport, Long Island, Vol. XV., 1891, p. 215, records the following illustrative cases:

4. *State v. Smith*, 54 Iowa, 104; 37 Am. Rep., 192.—In this case the Court said: "A child of the proper age may be exhibited to a jury as evidence of alleged paternity. Precisely what should be deemed the proper age we need not determine. . . . A child which is only three months old has that peculiar immaturity of features which character-

izes an infant during the time it is called a babe. A child two years old or more has, to a large extent, put off that peculiar immaturity. In allowing a child of that age to be exhibited we think the court did not err."

In Iowa a distinction is made as to the admission of a very young infant and a child two years old in favor of the child two years old.

5. *Finnegan v. Dugan*, 14 Allen (Mass.), 107.—Here the Court said: "The fact of a resemblance between the child and the putative father was proper for the consideration of the jury. It is a well-known physiological fact that peculiarities of feature and personal traits are often transmitted from parent to child. Taken by itself, proof of such resemblance would be insufficient to establish the paternity; but it would be clearly a circumstance to be considered in connection with other facts tending to prove the issue on which the jury are to pass."

See also:

6. *State v. Woodruff*, 67 N. Car., 89.
7. *State v. Britt*, 78 N. Car., 39.
8. *Paulk v. State*, 52 Ala., 427.
9. *Stumm v. Hummel*, 39 Iowa, 478.

Also "Amer. and Eng. Encyclopædia of Law," Vol. II., p. 153, Bastardy.

10. *Young v. Makepeace*, 103 Mass., 50.—In this case the defendant in a bastardy proceeding denied that he was the father of the child, but alleged that one Dean was the father. The complainant then offered evidence to show dissimilarity between Dean and the child. Exceptions to the admission of the evidence were sustained, the Court saying: "We think also that the testimony to show points of the similarity between the child and Dean should not have been admitted. Even where there is a noticeable resemblance, there may be equally marked points of dissimilarity."

11. *Eddy v. Gray*, 4 Allen (Mass.), 435.—Points of dissimilarity, not implying a difference of race, do not tend to disprove paternity. They are, at most, of much less significance than points of resemblance, but proof of resemblance was excluded in this case.

12. *Keniston v. Rowe*, 16 Me., 38.—In this case the evidence excluded was of dissimilarity.

13. *Gilmanton v. Ham*, 38 N. H., 108.—In this case the resemblance was held to be properly a matter for consideration by the jury. But in this case the jury had both the child and the putative father before them, and took the fact from their own observation.

14. *People v. Carney*, 29 Hun (N. Y.), 47.—In this case evidence of the color of the child's eyes is not admissible to show its paternity.

See also:

15. *State v. Danforth*, 48 Iowa, 43.

16. *United States v. Collins*, 1 Cranch (U. S.), 592.
17. *Petrie v. Howe*, 4 N. Y. Sup. Ct., 85.
18. *Overlock v. Hall*, 81 Me., 348.
19. *Hanawalt v. State*, 64 Wis., 84.
20. *Robnett v. People*, 16 Ill. App., 299.

And "Amer. and Eng. Encyclopædia of Law," Vol. II., p. 152.

21. *State v. Smith* (Iowa), "Am. and Eng. Encycl. of Law," Vol. II., p. 153.—In this case the court decided that the child, two years and one month old, resembled the putative father "so closely as scarcely to admit of a doubt."

IV. SUBSTITUTION OF CHILDREN—SUPPOSITITIOUS CHILDREN.

In cases of supposititious children, unless there is present some peculiar mark, deformity, or characteristic, or unless there is some decided discrepancy as regards age, little or no positive medical evidence can be offered as regards the child or children.

Where substitution is attempted soon after delivery, or where attention is called to a supposititious child soon after the date of the pretended labor, certain phenomena connected with the umbilicus, skin, weight, and secretions of the child will enable us to state with an approach to accuracy the date of the child's birth.

Umbilicus.—"The stump of the umbilical cord remains relaxed and bluish-white for about twenty-four hours, when the red line of demarcation begins to show itself, which soon becomes moist; beginning with the amniotic sheath of the cord, the gelatin of Wharton and then the vessels are destroyed, while the rest of the cord appears flat, brown, and mummified. When the vessels of the cord have become very thin, it falls off, usually while the child is in the bath, from the third to the sixth day; somewhat later in small or prematurely born children than in those who are strong" (Winckel).

"In three-fourths of infants born at term the stump of the umbilical cord falls off within five days, but in premature infants the time is longer. The raw surface left by its detachment does not cicatrize for eight or ten days."[1]

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[1] Parvin: "Science and Art of Obstetrics," Phil., 1886, p. 544.

Skin.—The physiological icterus appears about the third to the fifth day (Winckel). See also Characteristics of the Fully Developed Child (p. 284).

Weight.—The child loses in weight during the first three or four days, for various reasons. "The navel having healed up, if the child is healthy and nursed by a healthy mother, it begins to gain again about the fourth day, and by the seventh or eighth day is as heavy as it was at birth" (Winckel).

Secretions.—The meconium, dark brown in color, so named from its resemblance to the juice of the poppy, may usually be observed in the discharges from the bowel for three or four days after birth, after which the stools become light canary or saffron colored. A microscopical examination of the meconium reveals lanugo, epithelial cells, and nuclei.

Instances have occurred in which women have pretended that they have been recently delivered and a child has been produced in proof of the same. In such a case all doubt is removed by a thorough and careful physical examination of the woman (see Feigned Delivery). Even in those instances in which a medical examination fails to elicit positive proof, or where, for some reason, the examination cannot be obtained, "the imposture is apt to be disclosed by some accidental or unforeseen circumstance."[1]

Upon the substitution of children, Casper ("Forensic Medicine," New Sydenham Society, London, 1864, Vol. III., p. 397) says:

"This deceit, which the Penal Code threatens with a degrading imprisonment for many years, is but of rare occurrence in ordinary life; not, as is usually said, because the interests at stake are not of so much importance as where one heir to a property or to a throne is substituted, since his own interests seem to each individual quite as important as these, but because the deceit is very difficult to set agoing and to carry out, and because it requires the assistance of cognizants and accomplices, unless indeed the child be stolen, as in a case of Klein's 'Annals of the Law.' In this case a peasant-woman wished to force a marriage. She made the man drunk, induced him to have intercourse with her, feigned pregnancy, and finally set fire to a house in which a neighbor had been delivered of twins, stole one of these children, and produced it as her own child of which she had been delivered. In other cases the extortion of money from the alleged seducer and father, more rarely the affecting wish of a childless wife to gladden her spouse by making him a father (this was the cause of the last case of the kind which came before me), finally in most cases the desire to obtain an inheritance of some kind or other, is the moving cause of a fraud of this nature.

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[1] Wharton and Stillé, vol. iii., p. 29. In the recent Hamilton case in this country, a quarrel between the mistress and the supposititious child's nurse was the primary cause of the disclosure of the fraud.

"The writers on this subject have been also guilty of introducing, in regard to it, ideas foreign to forensic medicine, when they continually speak of the 'genuineness' of the 'legitimacy,' and of the 'power to inherit' of the child, ideas which belong to the statute book and the science of law, and with which forensic medicine has nothing to do. The latter has only to consider the criteria according to which it may be actually determined in any given disputed case, whether this woman has given birth to this child, as she asserts she has, while the opposing party declares she has not, and that the child is supposititious.

"More rarely, the case of substitution is, as it were, relative; that is, the fact disputed is not whether the woman has been delivered or not of the child in question, as whether this child has been begotten by this man, who asserts that the child is supposititious as far as he is concerned. Both cases coincide in regard to the medico-legal examination. In the first place, it is necessary to determine whether the alleged mother has ever given birth to a child at all. The signs of delivery (pp. 36, 37) will decide this point. If it should be discovered that she has never given birth to any child, then the fraud is at once proved. The case is more difficult where she has produced a child, but perhaps one of an undesired sex, such as a daughter when a male descendant was required, or when, instead of a living child, which alone could serve her purpose, a dead one has been born.

"In order to ascertain the truth in these cases, when possible, the age of the child said to have been born must be ascertained and compared with the alleged period of delivery. A fraud might thus be possibly easily detected, such as, for instance, when a child alleged to be three days old is exhibited with a completely formed navel. Has, however, the alleged mother, who has actually produced, had the cunning to substitute a child of the same age with her own,—then the medical jurist will, in general, have to declare the impossibility of his being able to give a decisive opinion. Because the resemblance of the child to its putative father, which we are advised to pay attention to, is a most uncertain mode of proof, particularly in the case of new-born or very young children. In such children, especially in the new-born ones, the resemblance in features to parents or relations is, in most cases, not yet developed; moreover, the power of discovering a likeness is something quite individual; and, finally, it is well known that it is no law of nature that children must resemble their father or mother, and that many exceptions occur to this. Yet it is but a few years since a singular case came before me officially, in which the criterion was of itself sufficient; it was a case of what I have termed relative substitution, in which the resemblance was based upon the difference of race. A white woman had a liaison with a negro of this city, and had a son by him aged four years, who exhibited all the peculiarities of a true mulatto. The woman, however, produced a second boy, the paternity of which the negro denied, as he suspected the woman of having had intercourse with a (white) laborer. The second child, eleven months old at the time of my examination, was, however, also a completely developed mulatto, and could, not, therefore, have been begotten by a white man out of its white mother. In this case, therefore, the absence of fraud was indubitable. It is somewhat remarkable that a precisely similar case had occurred in Berlin in the year 1790. It gave occasion to a report by the superior medical college, which gave itself the trouble of proving by many quotations, 'that a white child born by a white mother could not have been begotten by a black man.' Remer goes still further than the mere difference of race, for he points out that congenital family peculiarities descend for generations; and of this he gives illustrations, such as a crooked little finger on each hand, red hair, stuttering, absence of the same finger-joints, and blindness; and modern physiological experience might very much enlarge the list. Remer asserts that when such peculiarities are observed upon a child said to be supposititious, that then its 'genuineness' is certain; but, however, when these are absent, the reverse is not to be concluded with certainty, but suspicion is justified. This assertion is tenable enough when the malformation or peculiarity in question is remarkable and indubitable, and is also of rare occurrence, but it must not be made to include 'red hair' or 'stuttering' and the like, which from their frequency might occur by chance, nor even a mole, etc., which might lead to mistakes; just because, however, such cases are of extremely rare occurrence as judicial ones, so, therefore, this criterion, taken from the resemblance of the child, is almost worthless for medico-legal practice. Just because, on the whole, frauds perpetrated by the substitution of children are, in a medico-legal point of view, always difficult, and under many circumstances impossible to detect, while their results are of the highest importance to families, morality, ay, even to public weal; therefore families and nations, from olden times, prescribed by statute certain precautions for the prevention of these frauds. In ancient dynasties, as in the Bourbons, the birth of a new member and possible heir to a throne is attended by solemn statutory forms, which have for their object and intention that the whole act of delivery should proceed before trustworthy witnesses, the highest officials of the crown and state, etc., which is certainly the sole method of attaining perfect certainty. In all statute books similar regulations are contained. These commence to take action in the respective cases even during pregnancy, which is submitted to a continuous control, etc.,—but forensic medicine does not require to enter further upon this subject. It has also been imagined that in a case of twins the second-born child might be preferred, and, as it were, substituted for the first-born, and endeavors have been made to ascertain how a substitution of this character could be found out."

ILLUSTRATIVE CASES OF THE SUBSTITUTION OF CHILDREN.

1. *Balfour, T. A. G.: Brit. Med. Jour., Feb. 14th*, 1880, *p.* 241.—Dr. B. attended a Mr. X. at his death. Two months afterward he was sent for to see Mrs. X., and was given to understand (a nurse being in the room at the time with an infant in her arms) that she had been confined. He was told that the child had been born at 5 P.M. the previous evening, before the nurse had arrived. She explained she had not sent for the doctor because it was a rough night, and that a neighbor had waited on her. The chemise was well stained with blood. On examination, however, it was evident that she had never given birth to a child. Further, the age of the child did not correspond to the time of its supposed birth. She confessed at last that it was not her child. An after-birth had been sent to her along with the child shown, in order to make the case appear the more real. The object of the deception was to acquire property which otherwise would have gone to her husband's relatives. In this case the husband had died two months previously, intestate, leaving some property, of which one-third only would revert to the widow. The widow stated to friends of her husband that she was pregnant and that she expected to be delivered in two months. At the expiration of this time an unmarried woman is delivered of a child at some distance, and the scheming widow obtains both child and after-birth, betakes herself to bed; and calls her physician as above stated.

The deception was discovered, both from an examination of the woman and the substituted child's navel, which latter was a day older in appearance than would correspond to the date of the alleged delivery. The conclusion to be drawn is, that not even the presence of both child and after-birth is sufficient to establish the diagnosis of delivery.

2. *R. v. Skepelhorne and wife. Brit. Med. Jour.*, 1870, *I., p.* 88; Central Criminal Court, Feb., 1870 (quoted by Tidy).—The prisoners were charged with conspiring to deceive a man named Ironside, by falsely representing that his wife had given birth to a female child. Mrs. Ironside, who had been married about nine months, was in collusion with the prisoners. The child of another woman was secured, and the

nurse obtained a "sheep's pluck" (which they afterward burned) to represent the after-birth. Dr. Taylor justly says that medical men must not consider all stains or marks of blood on bedding in a room as conclusive proof of delivery. In his charge to the jury Mr. Justice Byles remarked on the enormity of such a crime, where large estates and the rights of legitimate heirs were concerned. He thought, however, Mrs. Ironside did it mainly to please her husband. The prisoners were convicted.

3. *Robert Ray Hamilton Case, New York.*—Mr. Hamilton kept a mistress. Some time in the latter part of 1888 she represented to him that she was pregnant by him. He believed this to be the case, and he gave her considerable sums of money to enable her to go into the country and be confined. She went away, remained a few months, and upon her return produced a child which she stated was the child born at her alleged recent confinement. He fully believed her story and accepted the child as his own.

It appears from the police memoranda that several children were bought from midwives for sums of from ten to fifteen dollars, and that two of these died while acting their parts of supposititious children.

For some cause the fraud was finally discovered, and the woman with her accomplices was indicted for obtaining money by false pretences. The indictment never came to trial.

4. *Rüttel: Henke's Zeitschrift* (quoted by Wharton and Stillé, Vol. III., p. 29).—A girl, in order that she might persuade her lover to marry her, feigns pregnancy and delivery. She steals an eight or ten weeks' old infant and pretends that it is her own. The fraud is quickly and easily discovered; first, from the entire absence of any signs of a recent delivery; and, secondly, from the child evidently being much older than was consonant with the alleged date of birth.

5. *The Wicklow Peerage Case* (Committee for Privileges, April 1st, 1870, reported by Drs. Taylor and Tidy).—The title and estates of the Earl of Wicklow passed at his death to his brother's issue. The first in succession was George Howard, who after a career of dissipation died in October, 1864. He had been married in February, 1863, to Ellen Richardson, a coachman's daughter. In default of issue the estates devolved on his brother Charles, the second in succession. Ellen Howard (*née* Richardson) produced a male child, born, she alleged, on the 16th of May, 1864, and who, if such were the case, would be the son of her husband, George Howard, and the rightful earl.

Mrs. Howard was at the time living in lodgings, and the lodging-house keepers, Mr. and Mrs. Bloor, and a sister of the latter, one Rose Day, were the principal witnesses in favor of the claimant. Mrs. Howard was, or professed to be, taken suddenly ill on the date mentioned. Mr. Bloor went for a doctor, who was not at home. On returning, he was told that Mrs. Howard had been confined, and saw an infant in Rosa's arms. This was the whole of the evidence for the child's parentage.

The Lord Chancellor observed that the evidence was given by the witnesses with a firmness of demeanor and an absence of hesitation which would have commanded credence, unless it had been contradicted by all the surrounding circumstances. No medical man and no nurse attended Mrs. Howard, although it was her first confinement, and the infant would have been a seven months' child. It was neither registered nor baptized.

There was further strong evidence that she had not borne a child. and that the child she produced as her own was obtained by her from a girl who had been recently delivered in the Liverpool workhouse. Mrs. Howard was clearly identified as the person who had taken away a child from the workhouse about this time. Her story was thus proved to be false. The House of Lords decided against her claim and came to the conclusion that the witnesses had been guilty of perjury.

DISPUTED PREGNANCY, LABOR, AND THE LYING-IN STATE.

Under this heading we shall deal with the following subjects:

I. The symptoms and signs of pregnancy in the living.

II. Feigned pregnancy; feigned labor; feigned lying-in state; signs of recent delivery in the living; signs of recent delivery in the dead; corpus luteum.

III. The impregnation of a second ovum, an embryo already occupying the uterus; superfœtation.

IV. The period that must elapse after delivery before the woman can again become impregnated.

V. Unconscious impregnation, pregnancy, and delivery.

I. THE SYMPTOMS AND SIGNS OF PREGNANCY IN THE LIVING.

Diagnosis of Pregnancy in the Living.

The classification[1] and division of the various symptoms and signs of gestation, which seems to the writer to be by far the most convenient for the legal physician, and appropriate for

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[1] Very many classifications of the different symptoms and signs of pregnancy are proposed by various obstetric authorities. Some speak of the symptoms of pregnancy, others merely of the signs, and still others of the symptoms and physical signs.

We hear of subjective and objective symptoms, of rational and the present work, is to group them collectively as signs, and to enumerate them, not in point of time, but according to their relative value, commencing with the least. We shall describe then:

I. The doubtful signs of pregnancy.

II. The probable or presumptive signs of pregnancy.

III. The certain, positive, or sure signs of pregnancy.

I. DOUBTFUL SIGNS OF PREGNANCY.

1. **Morning Sickness.**—Gastric disturbance in the form of nausea and vomiting is in some cases the earliest sign of pregnancy.

Dr. Montgomery says: "I attended a patient who was married on Monday and began to be squeamish on Saturday; her delivery took place within nine months."

It is not a constant sign of pregnancy. In some cases it is entirely absent, in others so severe as to imperil the life of the woman. It occurs in more than one-half the cases of gestation, is more frequent and severe in primiparæ and in women of a highly nervous organization. Appearing in the fourth or fifth week of gestation, it continues with varying severity, usually until the fourth month. In rare cases we observe it continuing through pregnancy.

Nausea or actual vomiting most often troubles the pregnant woman when she first attempts to arise in the morning. More often there is nausea and retching without actual vomiting. After a varying period of nausea and retching the woman succeeds in bringing up a quantity of glairy mucus. The trouble may then disappear and she may even enjoy her breakfast, or

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sensible, and of doubtful, presumptive or uncertain, probable, and certain signs of gestation.

One authority classes each symptom in the order in which it presents itself as regards time according to months, another according to periods (three months each).

It may be stated here that the first class—the doubtful signs of gestation—are so uncertain that they may be observed in the male as well as in the female under certain conditions. They are the result of the changes that are going on in the maternal organism, and are produced partly by pressure and partly by alterations in the mother's blood, skin, and nervous system due to other causes.

The second class—the probable signs of pregnancy—have their origin almost entirely from the genital organs of the woman, and have to do then entirely with the mother.

The third class—the certain signs of pregnancy—are produced by the presence of a fœtus within the uterine cavity, and consequently concern the child alone it may persist with greater or less severity for the entire day. It may even awaken her by night and cause her to vomit.

The attempt has been made (Dewees) to attach a diagnostic significance to the spitting by a woman of a white, frothy mucus —"cotton spitting" as it is sometimes called.

Morning sickness, as an indication of pregnancy, when standing alone is merely a doubtful or uncertain sign. Associated with other signs it may even render the diagnosis probable. For instance, a woman in apparent perfect health suffers at the same time from morning sickness, amenorrhœa, some slight enlargement of the abdomen, and perhaps a frequent desire to pass water during the day while in the erect or sitting posture.

2. **Sympathetic Disturbances.**—These involve

(*a*) THE NERVOUS SYSTEM.—Here various manifestations are presented. An unusual irritability of temper may show itself, with fretfulness, wilfulness, or an uncommon mildness is present, or perhaps despondency. Some show alterations in temper, others in disposition.

(*b*) THE DIGESTIVE SYSTEM.—The most common disturbance, that of morning sickness, we have already discussed.

We frequently observe perversion of appetite. Entire absence of appetite or an increased demand for food is present. Some women experience what is popularly termed "longings" or "cravings." These consist in a desire for unusual, unheard-of, or even disgusting articles of food.

In the early weeks we often observe profuse salivation, pyrosis (water-brash), acid eructations, heartburn, diarrhœa, or constipation alternating with diarrhœa.

(*c*) THE CIRCULATORY SYSTEM.—Here we observe symptoms due to what was at one time termed general plethora. Flushings of the face, that may be described as painful, are observed, also sensations of heat alternating with those of cold. There may even be a rise of temperature of a degree or fraction thereof.

These sympathetic disturbances are in all probability caused by reflex spasm of the smaller blood-vessels in the early months, and later by actual changes in the maternal blood itself.

3. **Rectal Disturbances.**—The sinking of the enlarging uterus in the first third of gestation may, by pressing upon the

rectum, cause irritation. Pre-existing hemorrhoids may be aggravated, new ones formed, or constipation or diarrhœa produced.

4. **Bladder Disturbances.**—For the same reason an irritable bladder may result, showing itself principally in the frequent desire to pass water during the daytime. Examination of the urine in some instances will reveal even a mild catarrhal inflammation of the bladder which causes the usual symptoms of pain, frequent micturition, tenesmus, and scalding.

Irritability of the bladder is so constant, especially in primiparæ, in the early weeks of gestation, that some authorities attach considerable importance to this symptom when associated with that of cessation of menstruation.

5. **Enlargement of the Abdomen.**—During the first two months of gestation little if any perceptible enlargement of the abdomen occurs. Indeed, the lower part of the abdomen—hypogastric region—may be even flatter than in the non-pregnant condition, due to the sinking of the uterus lower in the pelvic cavity as a result of its increased weight.

In the third month some enlargement of the lower part of the abdomen occurs.

In the fourth month the cause of this enlargement—the pregnant uterus—may be palpated.

6. **Pain.**—Pain as a symptom of pregnancy is not always present. When it does occur it is usually in the later months, and in the last fortnight is caused by the falling womb pressing upon the pelvic nerves, or upon a knuckle of intestine caught between it and the pelvic basin.

7. **Varicosities and Œdema of the Lower Extremities.**—These are mere pressure symptoms and occur late in pregnancy, are not constant, but when present cause considerable pain and annoyance to the patient.

8. **Alterations in the Skin.**—Deposit of pigment may occur in various parts of the body, as abdominal walls, face, forehead, mammæ, labia. Irregular brownish, sometimes yellowish patches often appear upon the forehead and face.[1]

Of the above the most characteristic and constant is the pigmentation upon the anterior abdominal wall. It appears early, and extends from the pubes to and around the umbilicus (umbilical areola) and still following the median line sometimes reaches the ensiform cartilage. In blondes and the red-haired this is indistinct; in brunettes most marked.[1] Seborrhœa and eczema of the face and head are sometimes seen (Spiegelberg).

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[1] "Mask of pregnancy."

II. PROBABLE SIGNS.

1. **Cessation of Menstruation.**—Usually this is the first sign of gestation. The suppression of the menses is what in the majority of cases first calls the woman's attention to her condition.

The French (Cazeaux) are accustomed to describe a more voluptuous sensation as characteristic of a fruitful cohabitation. But this sign, together with the retention of the semen after intercourse, a peculiar condition of the eyes, a swelling of the neck, as signs that pregnancy has taken place, are too uncertain to be more than mentioned.

In a female enjoying perfect health, and who has not previously suffered from menstrual derangement, the cessation of menstruation, alone or in conjunction with other uncertain signs, would render the presence of pregnancy probable. Certain conditions, however, detract from the value of this probable sign of gestation. These are three in number:

(*a*) Other causes than pregnancy may determine the arrest of menstruation. Perhaps the most common of these is taking cold. Simple wetting of the feet in some persons, as is well known, will cause an arrest of menstruation.

Mental impressions will affect the menstrual flow. In the unmarried, fear following illicit sexual intercourse will sometimes produce a suppression of one or more periods, and in the married the same cause or an intense desire for child-birth will do the same.

Tuberculosis, as is well known, is a very common cause of amenorrhœa, and debility and anæmia from other causes, as syphilis, may do the same.

(*b*) Pregnancy may take place in the absence of menstruation. Pregnancy may occur in a young girl who has never menstruated. She may become pregnant before puberty; "she may bear fruit before flowers."

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[1] Barnes (Trans. Amer. Gyn. Soc., vol. i.) ascribes the pigmentation of pregnancy to a functional change in the suprarenal capsules. Jeannin (Gazette Hebdo., 1868) advanced the amenorrhœa of pregnancy as the cause.

Then, as is well known, gestation may occur in women during the amenorrhœa of lactation. When a woman nurses her child at the breast, menstruation is normally absent. In the majority of cases (seventy-one per cent[1]) menstruation is re-established by the end of six months from the date of confinement, and it is during this period of amenorrhœa that impregnation may and does occur.

Then there are a certain number of cases on record where women have become pregnant after apparently passing the change of life.[2]

(*c*) What is apparently menstruation may occur, with more or less regularity, through a part or the whole of pregnancy. During the first three months of gestation, before the decidua reflexa is pushed out by the swelling ovum and becomes blended with the decidua vera, these cases of menstruation during pregnancy are not difficult of explanation. After the completion of the third month, while some cases may be explained by the presence of an eroded cervix, a cervical polypus, placenta prævia, or extra-uterine pregnancy, yet a certain number cannot be so explained away.

2. Changes in the Vulva, Vagina, and Portio Vaginalis.—(*a*) EXTERNAL GENITAL ORGANS.—Some time in the first third of gestation, upon an inspection of the external genital organs, the following conditions may be found; they become more marked as pregnancy advances.

The greater and lesser labia are somewhat increased in size; they become more elastic, more resisting to touch, and in brunettes a deposit of pigment may often be seen under the skin of the external lips.

The normal red or pink color of the inner surfaces of the labia minora as pregnancy advances gives place, in some cases, to a decided blue, violet, or even purple color.

The functional activity of the glands increases as pregnancy advances, and the parts are bathed by more or less glairy mucus in consequence. Dilatation, engorgement, and even a varicose condition of the blood-vessels may be seen in the later months.

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[1] Carl Braun: "Lehrbuch d. g. Gyn.," Wien, 1881, p. 211.

[2] Parvin: "Science and Art of Obstetrics," Phila., 1886, p. 178.

Often the tumefaction, or perhaps œdema, present in the labia causes them to separate and thus expose the entrance to the vagina to a greater or less extent.

(*b*) VAGINA.—Pregnancy here causes in many instances a puffy and swollen condition of the mucous membrane, with usually an increase of the mucous secretion. The surface is often roughened by the enlarging papillæ. The temperature is increased slightly according to good authority, and the vessels may often be felt pulsating, giving rise to the term "vaginal pulse."

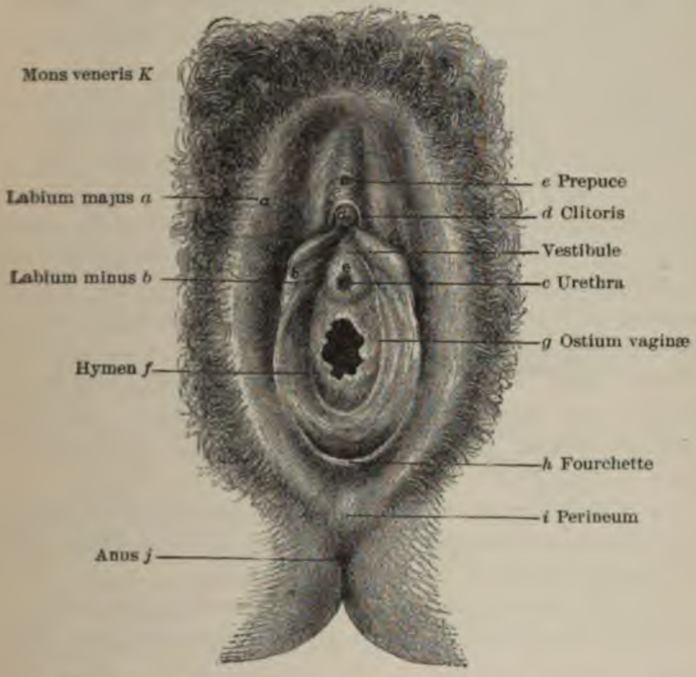

FIG. 40.—External Genitals of Virgin, with Diaphragmatic Hymen. The labia majora and minora are drawn apart and the prepuce drawn back. The cadaver is in the lithotomy posture. (Modified from Sappey).

All of the above changes are of little significance, since all may be present under conditions other than pregnancy.

One change, however, is important and is certainly a valuable aid to the diagnosis of the pregnancy before more reliable signs are to be appreciated. We refer to the violet hue of the mucous membrane, especially described by Jacquemin and Kluge,[1] and recently carefully investigated by Chadwick.[2]

The sign is usually present as early as the second month. It is first seen as a pale violet on the anterior vaginal wall near the meatus urinarius, in contrast with the normal pinkish hue of the vagina. As pregnancy advances the color deepens, involves the whole vagina, and finally becomes bluish, or almost black in tint.

Kluge states that the bluish color of the vaginal vault may be observed as early as the fourth week, or at "the time when menstruation would have occurred had conception not taken place."

Chadwick[3] observed 281 cases of pregnancy with reference to this sign. Of this number, at the end of the second month of gestation, the sign was suggestive in 34 per cent, and diagnostic in only 13 per cent. At the end of the third month the sign was suggestive of pregnancy in 27 per cent, and diagnostic in 46 per cent. At the end of the third month Chadwick was unable to find the change in color in 17 per cent. He sums up as follows regarding the value of this violet or bluish discoloration of the vaginal mucous membrane.[4]

"1. That its absence is not to be accepted as evidence that pregnancy does not exist, especially in the first three months, when satisfactory evidence is most needed.

"2. That from (and including) the second month this color is generally present, and often of such character as to be diagnostic."

Farlow[5] observed 141 cases of pregnancy in reference to this sign. At the end of six weeks the bluish color was suggestive of pregnancy in one case. At the end of the second month, of 22 cases observed, the discoloration was suggestive of pregnancy in 10, and diagnostic in one case. At the end of the third month, out of 28 cases observed, the sign was suggestive in 5, and characteristic in 11.

It will be readily seen from these investigations that the sign is not an infallible one. At the end of the third month it was not observable in 17 per cent of Chadwick's cases and in a greater proportion of those of Farlow. Other conditions, physiological and pathological, may produce appearances identical with those of gestation. Montgomery has observed the same blue color after menstruation. The writer has frequently observed the blue color just before as well as immediately after menstruation in dispensary practice. Chadwick mentions a case of erotism as causing the same discoloration. Many pathological conditions of the uterus and other pelvic organs which produce venous stasis give a blue coloration to the vaginal mucous membrane. For the above reasons we have placed this sign among the probable ones of gestation.

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[1] Sommer: Berl. med. Central-Zeitung, Jan. 14th, 1837.

[2] Trans. Amer. Gyn. Soc., vol. ii., 1886, p. 399.

[3] *Loc. cit.*

[4] *Loc. cit.*

[5] Boston Med. and Surg. Jour., vol. cxvii., No. 3, 1887.

(*c*) PORTIO VAGINALIS.[1]—During the early weeks of pregnancy the cervix uteri undergoes no change except, perhaps, as regards its position. We usually find it somewhat lower in the vagina at this time and more readily felt, in consequence of the increasing weight of the uterus causing that body to descend somewhat in the pelvis. We find it also deflected to the left side at this time.

By far the most important change, however, in the neck of the womb as a result of pregnancy is the change in its consistency. Early in pregnancy the cervix commences to soften from below upward, and this softening is especially marked in women who have already borne children (multiparæ), and in these the change may be appreciated as early as the sixth week. In almost all cases of pregnancy (multiparæ and primiparæ) the change can be readily made out in the third month.

The softening begins about the external os, and at first (in the early weeks) gives to the examining finger the sensation of pressing upon something hard through an intermediate soft substance, as where the surface of a table is pressed upon with the finger through a plush cover. The softening continues until by the end of gestation the whole neck of the womb is involved, and then its consistency is so similar to that of the walls of the vagina that the one is with difficulty distinguished from the other.

Goodell,[2] who attaches great importance to this change as a proof of the presence of utero-gestation, states: "When the cervix feels as hard as the tip of the nose, pregnancy does not exist, but when it is as soft as the lips, the womb most probably contains a fœtus."

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[1] Intravaginal portion of the neck of the womb.

[2] Med. Press and Circ., Dec. 16th, 1877, p. 524.

The value of this sign, when we most need its assistance for determining the pregnancy, namely, in the first months, is of a probable nature only. Certain morbid conditions of the cervix may cause the absence of the sign in the presence of gestation; and pregnancy being absent, other morbid states may produce softening of the cervix. Among the former is hypertrophic elongation; among the latter, acute metritis, hæmatometra, and like conditions.

Shortening of the cervix during pregnancy was at one time believed to occur and to be a valuable sign of the condition. Now we know that the shortening is apparent only, observers having been deceived by the softening passing unrecognized as cervical tissue.

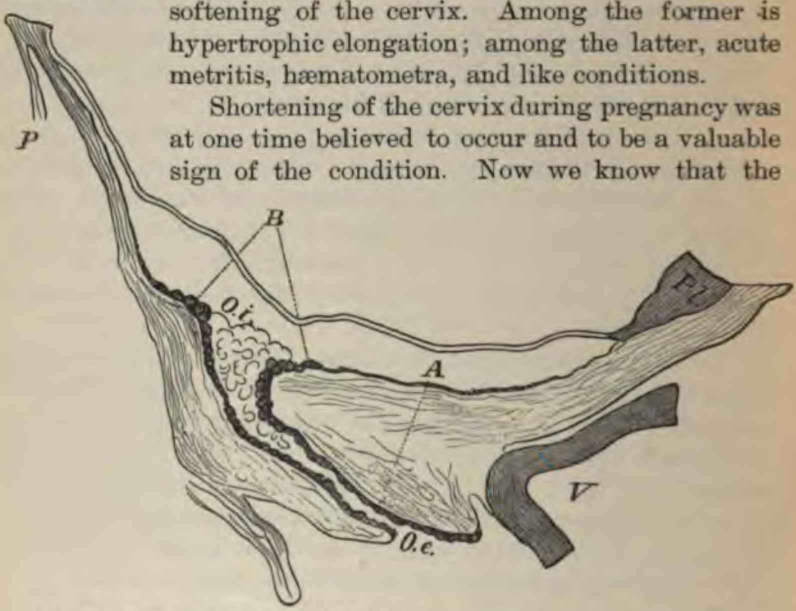

FIG. 41.—*B*, Borders of the cervical mucous membrane; *Pl*, placenta; *V*, bladder; *O.i.*, os internum; *O.e.*, os externum; *Aa*, apparent length of cervical canal on digital examination.

3. **Changes in the Size, Form, and Consistency of the Uterus. Fluctuation.**—(*a*) SIZE.—During gestation the uterus gradually increases in size, but it is not until the end of the third month that the fundus of the organ rises above the brim of the pelvic basin.

At the end of the fourth month it is a few fingers' breadth above the pubic symphysis.

At the end of the fifth month, half-way between the symphysis and the navel.

At the end of the sixth month, at the umbilicus.

At the end of the seventh month, half-way between the umbilicus and the ensiform cartilage.[1]

At the end of the eighth month, at the ensiform cartilage.

At the end of the ninth month (full term), same as end of seventh.

(*b*) FORM.—The normal (unimpregnated) uterus is pear-shaped, flattened from before back. Pregnancy causes it to belly out over the neck in all its transverse diameters, so that by the second month it resembles in shape "an old-fashioned fat-bellied jug" which has been inverted in the pelvic cavity.[2]

In the middle of pregnancy it is almost round, and at full term it becomes elongated again, flattened somewhat from before back.

(*c*) CONSISTENCY.—The normal (unimpregnated) uterus feels hard, resisting, non-elastic, non-compressible; resembling a mass of fibrous tissue somewhat. Pregnancy causes all this to change. Softening and compressibility commence in what is known as "the median section of the lower uterine segment."

"The compressibility of this median section is asserted to be sometimes so great that the mass of tissues grasped between the fingers seems to be no thicker than a visiting-card, or actual solution of continuity between the body of the uterus above and the neck below is apparent" (Jaggard).[3]

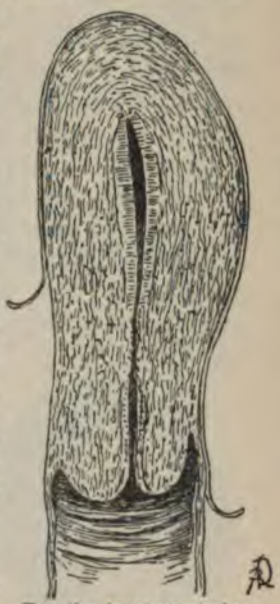

FIG. 42.—Antero-posterior Section Through the Uterus of a Woman who has Never Borne Children.

This new sign of pregnancy Hegar,[4] whose name it bears, believes to be a reliable one. The sign is valuable in early pregnancy, but sufficient time has not elasped since Hegar called attention to it to pass judgment upon its fallibility. Six cases of the diagnosis of pregnancy in the early weeks by this sign alone are reported by Reinl. Eight are recorded by Compes, and in one the diagnosis was made at the seventh week. In one case he was unable to detect it, and observed somewhat similar phenomena in cases of uterine displacement (retroversion).

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[1] Lower end of the breast-bone.

[2] See article by R. L. Dickinson, M.D., New York Jour. Gyn. and Obstet., vol. ii., p. 544.

[3] "Amer. Sys. Obst.," vol. i., p. 355. Sonntag: Amer. Jour. Obst., xxvi., 2, August, 1892, p. 145 *et seq.*

[4] Reinl: Prager medicin. Wochenschr., 1884, No. 26.

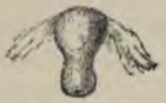

Fig. 43.—Unimpregnated Uterus (about ¼ natural size).

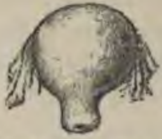

Fig. 44.—Uterus at Second Month of Pregnancy (about ¼ natural size).

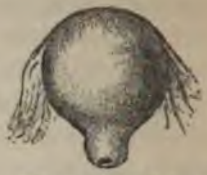

Fig. 45.—Uterus at Third Month of Pregnancy (about ¼ natural size).

The softening continues until the whole body of the uterus is involved, and in the later months, under favorable circumstances, the fœtus itself may be felt through the walls.

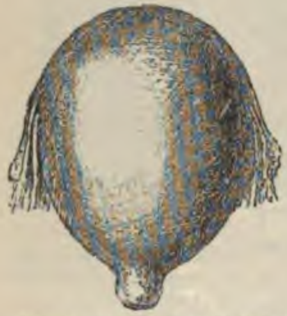

Fig. 46.—Uterus at Sixth Month of Pregnancy (about ¼ natural size).

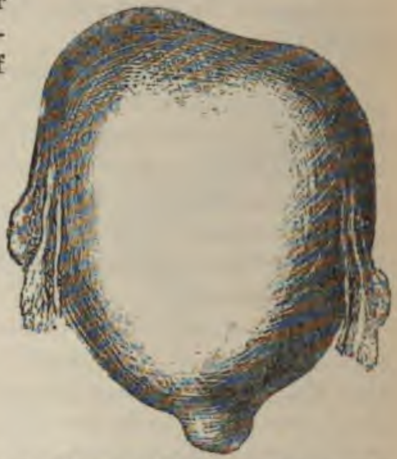

Fig. 47.—Uterus at Full-term (about ¼ natural size).

Schroeder[1] does not hesitate to state that: "The pregnant uterus is so characteristically soft, almost dough-like, from the second to the fourth month that in cases in which this change is present in a pronounced degree pregnancy is positively demonstrated." He (Schroeder[1]) further states: "If the uterus is found, upon bimanual exploration, of a size corresponding to the period of time (end of the third month), in a position of slight anteflexion, non-sensitive, of a peculiar consistency—if the woman is perfectly healthy, and if the previous regular function of menstruation has been suppressed for a corresponding period of time—the diagnosis of pregnancy is certainly established."

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[1] "Lehrb. d. Geburtsh.," 9te Aufl., Bonn, 1886, p. 109, quoted by Jaggard.

(*d*) FLUCTUATION.—Fluctuation may be obtained over the pregnant uterus, as in any fluid tumor, and there is nothing characteristic about the sign thus obtained, although some have laid great stress upon it as a sign of gestation.[2]

4. **Ballottement, Vaginal and Abdominal.**—Ballottement is either internal (vaginal) or external (abdominal).

From the fourth to the eighth month the fœtus floats in the liquor amnii, and passive movements may be communicated to the whole fœtus, and the appreciation of these movements constitutes the sign of pregnancy known as ballottement. Before and after the period named the fœtus is relatively too large as regards the quantity of liquor amnii to permit of the sign being made out.

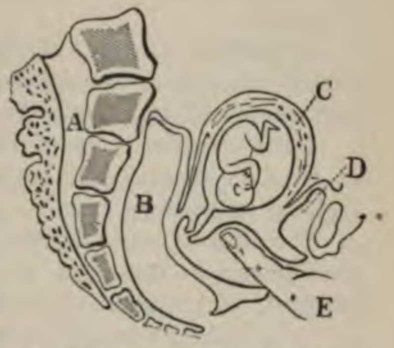

FIG. 48.—Examination for Ballottement. (King.) *A*, section of sacrum; *B*, rectum; *C*, uterus; *D*, bladder; *E*, examining finger.

Passive movements of portions of the fœtal body can, however, be appreciated until late in pregnancy when the presenting part becomes engaged in the pelvic cavity (Fig. 48).

To practise internal ballottement the woman either stands, takes the semi-recumbent or dorsal position. One or two fingers of the right hand are introduced into the vagina and applied to the presenting part of the fœtus through the anterior vaginal wall. The other hand is placed upon the fundus of the uterus through the abdominal walls. The internal fingers suddenly press up the fœtus. Its entire body is thus thrown upward and is felt by the external hand, and upon the sinking of the fœtus again by the internal fingers.

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[1] *Loc. cit.*, p. 110, quoted by Jaggard.

[2] Rasch: Brit. Med. Jour., Aug. 30th, 1873, p. 261.

To practise external ballottement the woman is placed upon her back and a hand is laid upon each side of her abdomen. With one hand a sudden jerk is made, and the fœtus is dislodged and felt to strike the other hand, just as a lump of ice floating in a tumbler may be displaced from side to side with the finger.[1]

The sign may also be obtained by placing the pregnant woman upon her side, with her belly hanging over the edge of the bed. The fingers of one hand are placed under the abdomen, and the other hand is placed upon the upper part. "The sensation of the recession of the fœtal body and the *choc en retour* are more distinctly perceived in this position than in the former" (Jaggard).

Regarding the value of this sign of pregnancy we may state that it can only be considered a certain sign of gestation when appreciated by an expert observer.

Many consider it one of the sure signs, but so many sources of error are possible that we have placed it among the probable signs of pregnancy.

The French use this method of diagnosis and give greater significance to this sign, when elicited, than do the German, English, or American obstetricians.

"The fallacies to which the sign is liable are numerous and not unimportant. A multilocular cystoma of the ovary (Pajot), a small ovarian cyst with a long pedicle, the non-pregnant anteflexed uterus (Cazeaux), the pregnant womb itself (Robert Barnes) floating in ascitic fluid, a wandering kidney, a calculus resting in the bas-fond of the bladder (Cazeaux), have actually caused sensations analogous to those of repercussion. It is usually possible, however, to exclude these sources of error."[2]

5. **Intermittent Uterine Contractions** (Braxton Hicks' sign).—In 1871 J. Braxton Hicks[3] stated before the London Obstetrical Society that during the entire duration of pregnancy the uterus was subject to alternate contractions and relaxations,

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[1] Tarnier.

[2] Jaggard: "Amer. Sys. Obst.," vol. i., p. 373.

[3] See also J. Braxton Hicks: "On the Contractions of the Uterus throughout Pregnancy, and their Value in the Diagnosis of Pregnancy, both Normal and Complicated." Transactions of the Ninth International Med. Congress, 1887.

at varying intervals, and claimed diagnostic value for this phenomenon.

Before the fourth month it is difficult to obtain this sign except by a very careful bimanual examination. After the fourth month, upon grasping the pregnant uterus through the abdomen, the organ will be felt to alternately contract and relax. The contraction usually lasts from three to five minutes, and the interval from five to twenty.

The value of this phenomenon as a sign of pregnancy is great. It is almost a certain sign.[1] Some class it as such.[2] To be sure, morbid conditions such as hæmatometra, physometra, soft fibroid tumors of the uterus, a distended bladder, may give the same sign; but these conditions can, with the exception of soft, rapidly growing fibroids, usually be readily excluded.

The sign is always present, even in early pregnancy. It has to do with the mother, and is entirely independent of the fœtus. The latter may be dead and degenerated without affecting the sign.

This sign is particularly valuable in cases of hydramniotic enlargement of the uterus, when it is difficult to obtain any of the certain signs of gestation, the excess of liquor amnii hiding them. Charpentier[3] reports a case where this sign alone enabled him to diagnosticate an acute hydramnios in the third month. An immediate artificial interruption of pregnancy resulted in the discharge of twin fœtuses and about fifteen quarts of liquor amnii.

6. **Uterine Murmur.**—Upon listening over the gravid uterus any time after the fifth month, and in exceptional cases earlier, a blowing sound, of variable quality and degrees of intensity, may be readily heard occurring synchronously with the maternal pulse.

This sound was first discovered by De Kergaradec in 1821, and "since that time has been successively designated placental souffle (Monod, Ulsamer, Hohl), abdominal souffle (Bouillard), simple pulsation (Ritgen), epigastric souffle (Kiwisch), and uterine souffle (P. Dubois, Dépaul, Naegele)."[1]

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[1] "Inasmuch, however, as the intermittent uterine contractions are closely simulated by at least one morbid state, more particularly during the early months, the symptom cannot be classified among the certain signs of pregnancy" (Jaggard: "Amer. Sys. Obst.," vol. i., p. 370).

[2] Lawson Tait says, "This is an infinitely more certain sign than the fœtal heart or the sound of the placental bruit" (Trans. of the New York State Med. Ass'n, Albany, 1886).

[3] Trans. of the Ninth Internat. Med. Congress.

The sound has been heard as early as the fourth month, and its intensity is said to increase up to the end of the seventh month.[2] Of 307 women examined by Dèpaul after the fifth month of gestation, he heard the uterine murmur in 295.

M. H. F. Naegele[3] found it in 580 out of 600 cases of pregnancy examined.

It is unnecessary here to go into the various theories regarding the cause of this sound. Suffice it to state that it is generally accepted as produced in the branching arteries of the uterus.

The value of this sign of pregnancy for diagnostic purposes is not great. A bruit or souffle closely resembling it is heard in certain morbid conditions independent of pregnancy, as in chronic enlargement of the uterus (metritis) and in certain uterine (myomata) and ovarian tumors.

7. **Mammary Changes.**—These changes, although in most cases they supply only presumptive evidence of gestation, are important, since not one but many signs of pregnancy may be obtained from them.[4]

A careful and systematic examination should be made with both breasts fully exposed, and the woman in the dorsal position. The changes to be noted are in the breast itself, in veins of the surface, the deposition of pigment into an areola and secondary areola, the enlargement of the glands of Montgomery, the nipple, together with secretion.

Changes in the mammæ begin with pregnancy, and at the end of gestation changes in one or more of the above situations may be noted.

At first inspection alone should be made use of, as it is quite possible by palpation to produce a physiological congestion, and thus the observer may be deceived as regards the size and firmness of the breasts.

In *inspecting* the breasts we note their enlargement which commences early in pregnancy. The superficial veins are seen to be more distinct and enlarged. These are more marked in women of a blonde type. After the sixth month stretching of the skin may cause silvery lines or striæ, similar to the lineæ albicantes of the abdomen, to appear, especially in primiparæ. Old ones appear white, new ones pinkish in color.

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[1] Jaggard: *loc. cit.*, vol. i., p. 381.

[2] Dépaul: "Traité Théorique et Pratique d'Auscultation Obstét."

[3] "Die geburtsh. Auscult.," Mayence, 1838.

[4] "The anecdote is related of John Hunter, that on inspecting the mammæ of a young girl whose body was arranged for a post-mortem examination, he pronounced her pregnant. The hymen was found to be intact, but upon opening the abdomen the diagnosis was verified" ("Amer. Sys. Obst.," vol. i., p. 362).

Pregnancy causes a darkening in the areola about the nipple, which is more marked in women of the brunette type. The tubercles (of Montgomery) upon its surface become enlarged and prominent. At about the fifth or sixth month, about the primary areola which has a diameter of about an inch, and which commences to darken early in gestation, small white spots become visible, presenting the appearance "of dust-covered white blotting-paper upon which drops of water have been sprinkled" (secondary areola of Dubois). Montgomery attaches great weight to these spots as signs of gestation.

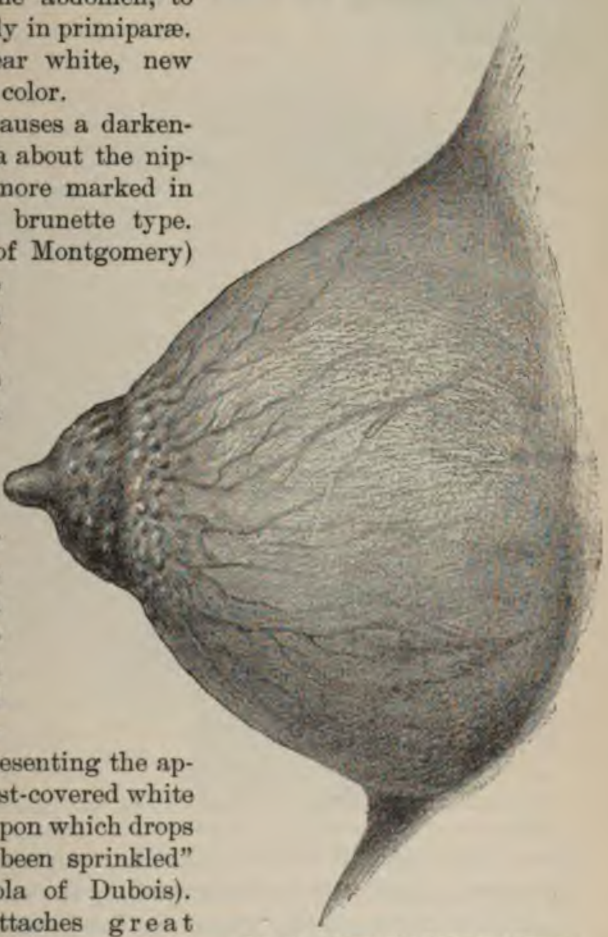

FIG. 49.—Breast of a Pregnant Woman Seen in Profile. (Ribemont-Dessaignes.)

The nipples themselves become enlarged, are harder, firmer, more sensitive, and take on erection more readily, than in the non-pregnant state. As early as the third month, upon the apex of the nipple minute branny scales may be seen, caused by the drying of the colostrum at this point. At this time also, upon careful manipulation a drop or two of a serous-like fluid can be squeezed from the nipple, which examined under the microscope may give colostrum corpuscles (see Fig. 51).

Upon palpating the breast itself it will be found harder, firmer, often painful, and more knotty, than usual—all of which changes progress with the growth of the fœtus.

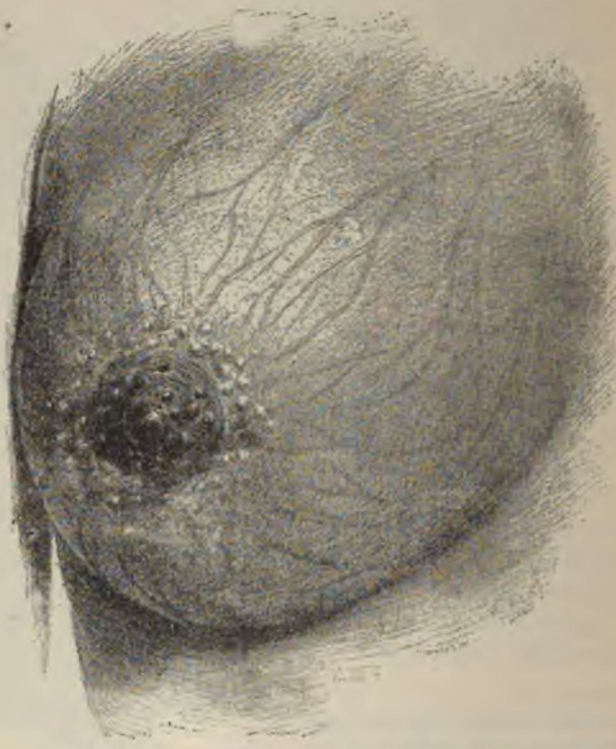

FIG. 50.—Breast of a Pregnant Woman. Anterior view. (Ribemont-Dessaignes.)

Milk does not usually appear in the breasts until labor, or even some time after; but, as already stated, a fluid known as colostrum may be squeezed out as early as the third month.

It occasionally happens that the breasts increase in size markedly up to the middle of gestation, then diminish in size and remain thus until labor occurs. Again, it is not uncommon, especially in elderly primiparæ, to observe little or no enlargement of the mammæ; and then these women are rarely able to perfectly nurse their child.

What is the value of these mammary signs of pregnancy?

The value of these mammary changes is lessened from the following facts:

1. Cases of pregnancy occur where little or no alteration takes place in the breasts until after labor, and in some instances not even then.

It is not uncommon to observe cases of pregnancy with little or no alterations and no secretion during or after gestation. Again other cases occur where there is no secretion while the woman is carrying her child, but a short time after labor a normal secretion is established.

As already stated, the breasts often, after the middle of pregnancy, diminish in size.

As is well known, impregnation may occur during lactation when the alterations already referred to, and the lacteal secretion, are present.

2. Mammary changes, together with the secretion of milk, occur independent of pregnancy.

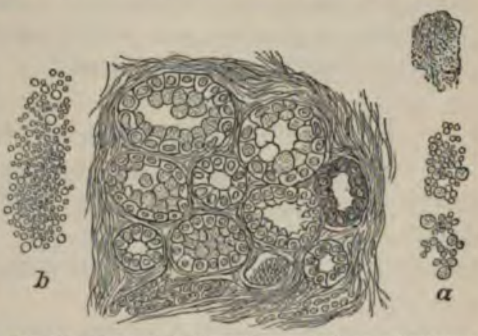

FIG. 51.—Mamma in Lactation, × 330. *a*, colostrum; *b*, milk. (Winckel.)

Well-authenticated cases of milk in the male breast have been recorded (Humboldt).

What is apparently colostrum has been frequently observed in the breasts of infants and very young children; this secretion being entirely independent of sexual excitement. Faye[1] examined 120 infants and found a secretion in the breast of all but 6; of these 4 were boys and 2 girls.

Milk has been secreted by the breasts of unmarried and non-pregnant women.

"Baudelocque presented to the Academy of Surgery of Paris in 1783 a female child eight years old who had suckled a little brother for more than a month."[1]

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[1] London Med. Record, Oct. 15th, 1877, p. 413.

Tanner states that "it is not uncommon to western Africa for young girls who have never been pregnant to regularly employ themselves in nursing the children of others, the mammæ being excited to action by the application of the juice of one of the Euphorbiaceæ."

It is common for sexual excitement and mechanical irritation of the breasts among nulliparous prostitutes to produce a secretion of colostrum from the mammæ.

8. **Changes at the Umbilicus. Striæ.**—The umbilical depression is somewhat increased or unchanged in the first third of pregnancy. During the following months it gradually disappears until in the last two there is a protrusion of the umbilicus ("pouting of the navel").

Usually in the first pregnancy, sometimes in subsequent ones, striæ, cicatrices of pregnancy, silvery lines, striæ gravidarum, or lineæ albicantes, appear upon the lower part of the abdomen late in pregnancy as the result of pressure, and occasionally upon the thighs and hips. Recent or new ones appear bluish-red or pinkish, old ones pearly or whitish. They are absent in from six to ten per cent.[2]

III. CERTAIN OR SURE SIGNS OF PREGNANCY.

1. **Palpating the Fœtus Through the Uterine Walls.**—"It is the most certain of all, because it is always appreciable; even in commencing abortion embryo or fœtus may be felt in utero, or in the case of a dead child, when all other sure signs fail."[3]

As early as the fourth month it is sometimes possible to feel the fœtal head through the anterior vaginal wall.[4]

This sign possesses its greatest value in the hands of those who have accustomed themselves to fœtal palpation. In the hands of the inexperienced many mistakes are liable to occur. Fibroids of the uterus, malignant diseases of the omentum and peritoneum, "and multilocular cystomata of the ovaries, especially in the presence of ascitic fluid, may closely simulate to the sense of touch the head, pelvis, and particularly the upper and lower extremities of the fœtus." [1]

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[1] "Amer. Syst. of Obstetrics," vol. i., p. 36.

[2] Hecker found them absent in six per cent, Credé in ten per cent; Schultze found them in thirty-six per cent of nulliparous women.

[3] Winckel: "Text-Book of Obstetrics," American edition, Phila., 1890.

[4] Carl Braun: "Lehrbuch d. g. Gyn.," Wien, 1881, p. 211.

Indeed, Winckel himself, who attaches such importance to this sign, narrates an instance where a physician mistook the fœtal head for a hæmatocele.[2]

2. **Fœtal Heart Sounds.**—The sounds of the fœtal heart constitute a certain sign of gestation when clearly heard and carefully compared with the maternal pulse and also that of the examiner.

The writer has not placed this positive proof of pregnancy first, because in the case of a dead fœtus, of course, the sign would be absent.

The sounds of the fœtal heart have generally been compared to the ticking of a watch under a pillow. The beat is distinctly double—a first and a second sound—with an interval between two separate pulsations twice that between the two parts of the pulsation, *i.e.*, between the first and second part.

HOW EARLY MAY THE FŒTAL HEART SOUNDS BE DISTINGUISHED?—Obstetric authorities are generally agreed that the sounds of the fœtal heart are usually first heard between the eighteenth and twentieth week of pregnancy. Under favorable circumstances they may be heard at the fifteenth or sixteenth week and exceptionally still earlier.[3]

Dépaul [4] states that he has recognized the fœtal heart sounds at the eleventh week; Tarnier, at the twelfth; and Routh and Verandini, using the vaginal stethoscope, at the twelfth week.

When once distinguished, they are usually heard with increasing intensity during the remainder of pregnancy.

Of 906 women examined by Dépaul [5] in the last third of pregnancy, these sounds were absent in only 8 instances. Of 180 women examined by Anderson of Glasgow, during the same time, the sounds were not heard in 12 cases, and these subsequently proved to be still-born children.

In exceptional cases the sounds have been inaudible throughout pregnancy, and yet labor at term has resulted in the birth of a vigorous child.

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[1] Jaggard: *Loc. cit.*, vol. i., p. 374.

[2] *Loc. cit.*, p. 108.

[3] Jaggard: *Loc. cit.*, vol. i., p. 375.

[4] Dépaul: "Traité Théorique et Pratique d'Auscultation Obstét."

[5] *Loc. cit.*

With what may the fœtal heart sounds be confounded?

The most frequent mistake is to take the pulsations of the woman's heart for those of a fœtus. Cases are on record where this has happened, and an abdominal tumor pronounced to be the pregnant uterus.[1] The observer's own cardiac pulsations may also deceive him. Mistakes are avoided by carefully observing that the fœtal heart sounds are not synchronous with either the woman's or the observer's.[2]

This is another sure, certain, positive sign of pregnancy. It is generally held to be more certain than any other single sign or combination of signs. The recognition of the sounds by a competent observer proves beyond a doubt both that pregnancy exists and that the fœtus is alive. "Their absence, however, does not warrant the assumption that pregnancy does not exist or that the child is dead."[3] As has been shown, it is only in exceptional cases of pregnancy in the later months that these fœtal heart sounds cannot be appreciated.

3. **Movements of the Fœtus.**—Upon applying the ear or stethoscope over the pregnant uterus it is possible to distinguish the sounds caused by the entire fœtus being displaced within the uterine cavity (general movements) or by the movements of the head or extremities (partial movements).

The sound produced by the total displacement of the fœtus can in some instances be distinguished as early as the third or fourth month of pregnancy. Toward the latter part of gestation the sounds become more evident and frequent,[4] and are heard most distinctly at the upper part of the uterus. This phenomenon constitutes the *bruit de choc fœtal* of Pajot.

Two sensations are appreciated—a slight gentle and sudden

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[1] Winckel, "Text-book of Midwifery," Phila., 1890, p. 109.

[2] "These sounds (fœtal heart sounds) are distinguished from those of the maternal heart, usually, by their frequency; also because there is a certain pause between them, and moreover because the intensity of the maternal heart increases from below upward, while the fœtal sounds are more distinct from above downward. It is well to note this, as in pathological conditions the frequency may be the same in both, or the fœtal sounds may even be less frequent than those of the mother, or, *vice versa*, the fœtal heart may continue to contract as usual, although the maternal pulse rate is exceedingly high" (Winckel: *Loc. cit.*, p. 90).

[3] Jaggard: *Loc. cit.*, vol. i., p. 380.

[4] Winckel counted eighteen in one minute; *loc. cit.*, p. 92.

bruit (the sound of the child's movement), and a dull sound or shock, not unlike the shock of the aorta—the impact of the whole or a part of the fœtus against the uterine wall.

Pajot claims for this sign that in the early weeks it is more easily appreciated than the fœtal heart sounds, and in some instances may be recognized before that sign.

In the early months this sign is of great value, but only in the hands of an experienced auscultator; in late pregnancy we have so many better and surer signs that this one ceases to be of value.[1]

4. **Umbilical Murmur.**—The fœtal, umbilical, or funis murmur or souffle is a short blowing, whistling, or cooing sound, synchronous with the fœtal heart sounds, that in a certain proportion of cases is heard over the pregnant uterus.

Massmann,[2] Ahlfeld,[3] and Bumm[4] believed that the sound occurred in the fœtal heart itself; Hecker[5] and Schroeder,[6] that it was produced in the umbilical region of the child; Bumm[7] and Pinard[8] that certain conditions of the vessels of the cord accounted for the sound.

In reviewing the whole subject Winckel[9] comes to the conclusion that "the sound must be produced, as a rule, in the umbilical vein."

This sign is not a constant one of pregnancy by any means, which fact lessen its value as compared with that of the fœtal heart sounds. Hecker[10] and Schroeder[11] found it present in fourteen to fifteen per cent of cases, and these figures agree with those of most authorities upon midwifery.

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[1] Sounds and noises heard over and about the pregnant uterus: 1. Uterine bruit. 2. Murmur in the inferior epigastric artery. 3. Intestinal sounds. 4. Maternal heart sounds. 5. Pulse of the aorta. 6. Vesicular murmur of the woman. 7. Friction sounds between uterus and abdominal walls. 8. Crepitating sounds due to the pressure of gases in the uterine and abdominal walls. 9. Blowing sounds in the uterus, due to putrefaction of child and development of gases. 10. Fœtal heart sounds. 11. Umbilical souffle. 12. Movements of child. 13. Sucking sounds (child's mouth). 14. Cry of fœtus (vagitus uterinus).—Winckel.

[2] Massmann: Monatschr. f. Geburtsk., iv., 81.

[3] Ahlfeld: "Berichte und Arbeiten."

[4] Bumm: Archiv f. Gyn., xxv., 177.

[5] Hecker: "Klinik der Geburts.," p. 27.

[6] Schroeder: "Schw., Geb. u. Wochenb.," p. 17.

[7] Archiv f. Gyn., xxv., 177.

[8] Pinard: Archiv de Tocol., 1876, p. 310.

[9] "Text-Book of Midwifery," Amer. ed., Phila., 1890, p. 92.

[10] *Loc. cit.*

[11] *Loc. cit.*

Since this sound is present in only a small proportion of pregnancies, since an experienced auscultator is necessary for its detection, and since, when present, the fœtal heart sounds are also present, its value as a sign of gestation is not great.[1]

Miscellaneous and Popular Signs of Pregnancy.

1. Enlargement of the thyroid gland.
2. Turning out of the toes—the woman thereby increasing her base of support.
3. A more erect attitude, with shoulders thrown back and abdomen forward, in order to better balance herself.
4. An appearance of well-being.
5. Kiestein or gravidin in the urine (utterly worthless; found in the urine of the male).
6. Cardiac hypertrophy, and stronger pulse.
7. Albumin and sugar in the urine.
8. Vertigo, syncope, tendency to faint.
9. Headache, occipital in character (test of Beccaria).
10. Temporary amaurosis, caused by anæmia of the optic discs and retina.
11. Pigmentation on the face and arms.
12. Diarrhœa, frequent micturition, salivation, alterations in character, temper, and appetite.

ILLUSTRATIVE CASES OF THE DIAGNOSIS OF PREGNANCY.

1. *Levy: Arch. f. Gyn., xv.*, 3, *p.* 361, 1880.—Cases of menstruation during pregnancy.

2. *Henke's Zeitschr. f. St. Arzneik.*—Fifty cases of menstruation during pregnancy reported by Elsässer. Two of these fifty menstruated nine times. Author concluded that the condition was not true menstruation, but a pathological hemorrhage.

3. *Maré, Leon: L'Union médicale, xxxvi.*, 47, *p.* 558, 1882.—Some time after the birth of a child menstruation sets in and continues for four months and then ceases; child meanwhile suckled; two months later woman is found in her sixth month of pregnancy, that is, she has menstruated while suckling a child, and while pregnant with a second one.

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[1] For the pathological significance of this murmur see: Winckel: "Zur Path. der Geb.," p. 223; "Text-Book of Midwifery," American edition, Philadelphia, 1890, pp. 92, 345, 354, 352, 366, 896.

4. *Oliver, J.: Lancet, London*, 1890, *i.*, 596.—Menstruation twice after conception, and colostrum on the 97th day in a primipara.

5. *Farrar: London Lancet, Dec. 12th*, 1874, *p.* 853 (recorded by Tidy, "Med. Jurisp.").—Female, æt. 7 years. Both breasts contained milk. Each gland measured two inches in diameter, and was considerably elevated.

6. *Jackson, Edwin: London Lancet, July 6th*, 1873, *p.* 34 (recorded by Tidy, "Med. Jurisp.").—Lactation in a female child æt. 8 days. About a teaspoonful of milk (?) was drawn from each breast on two successive days.

7. *Brit. Med. Jour., Jan. 1st*, 1876.—Milk secretion in a bitch nine weeks after being in heat. At the time she was not in heat.

8. *Havard, V.: New York Med. Jour., ix., p.* 440.—Cases of milk secretion in new-born children.

Parvin ("Science and Art of Obstetrics," Phila., 1886) gives some curious cases that have come under his observation as illustrative of the cautiousness and deliberateness the diagnosis of pregnancy demands:

9. "A young lady of high social position, and against whose purity there was no whisper or thought of scandal, is attacked with obstinate vomiting. There is a denial of menstrual derangement; the vomiting resists all remedies, and she dies, but while dying a fœtus of three months and a half is expelled.

10. "A woman having passed twenty years of married life childless, some months after the menopause becomes pregnant; the pregnancy is suspected by one attendant, and denied by another.

11. "A girl who has never menstruated, and who does not fully present the other signs of puberty, becomes pregnant by violence, and gives birth to a child when she is twelve years old.

12. "A woman has menstrual suppression, coincident abdominal enlargement, the mammary and many signs of pregnancy; but a post-mortem examination proves cystic disease of the ovary.

13. "A girl of twenty has never menstruated; her abdomen enlarges, her breasts are swelled and secrete; after a time severe uterine contractions occur, and a physician of large experience called to her during this attack declares she is in labor; the cause of the abdominal enlargement is accumulation of many months' menstrual secretion, and the uterine contractions simulating labor pains are the efforts to overcome the resistance of an imperforate hymen."

14. Pajot[1] relates a case where a pregnant uterus of four months was mistaken for an abscess and opened with the knife by a man held to be learned in his profession.

Tardieu[2] has asserted that the abdominal signs, the mammary changes, apparent fœtal movements, and efforts of labor, in fact, all the signs of pregnancy, may be observed, with one exception, and that is, the fœtal heart sounds, in the non-pregnant woman.

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[1] "Travaux d'Obstétrique et de Gynécologie."

[2] "Sur les Grossesses Fausses et Simulées."

II: FEIGNED PREGNANCY; FEIGNED LABOR; FEIGNED LYING-IN STATE; SIGNS OF RECENT DELIVERY IN THE LIVING; SIGNS OF RECENT DELIVERY IN THE DEAD; CORPUS LUTEUM.

1. Feigned Pregnancy. Pseudo-Cyesis.

Pregnancy, for various reasons, may be feigned or simulated.

Suits for damages or to compel marriage are frequently brought, and it then becomes the duty of the physician to render a decision in the case.

The pregnancy may be purposely feigned or simulated, or the woman in question may really believe herself to be pregnant. The latter condition is one well recognized in obstetric medicine and constitutes what authorities variously term false, spurious, or nervous pregnancy.[1]

In cases of feigned or simulated pregnancy a physical examination immediately removes all doubt. For although the woman may simulate many of the doubtful signs of pregnancy in her attempt to deceive, yet an examination of her person by the physician reveals none of the probable or sure signs, and the uterus is found of normal size.

The condition is observed in women who are advanced in years; in those who expect or have an intense desire to become pregnant; in women who marry late in life and are anxious to prove their power of reproduction. Most frequently we observe the condition in the woman who is approaching her menopause, when her menstrual flows have become scanty or have ceased for a time altogether, and a deposit of fat takes place in her anterior abdominal walls, and her intestines become distended by flatulence. In such a case many of the doubtful and some of the probable, but none of the certain signs of pregnancy are present.

For example, menstruation may cease, the mammary signs of gestation appear, even to the secretion of colostrum or milk; the abdomen becomes progressively more prominent; the woman assures her physician that fœtal movements (quickening) are present; and this may all end in what is termed spurious labor.

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[1] Pseudo-cyesis.

"The climax of the delusion of spurious pregnancy may be a spurious labor."[1]

The diagnosis of the condition is not difficult. Above all the physician should be on his guard against accepting any statements the patient may offer in regard to her condition, and in expressing an opinion to rely only upon the exclusion of the probable and certain signs of gestation, which he does by a careful physical examination of the woman.

2. Feigned Delivery.

From a variety of motives, as for extorting damages or charity, compelling marriage, disinheritance, obtaining admission into some charitable institution, or for no assignable reason women will simulate or feign delivery of a child.

A careful medical examination of these cases, if the simulated delivery is said to be recent, and if the various doubtful, probable, and certain signs of recent delivery are excluded, will clear away all doubt.[2]

T. Kost[3] says: "Testimony is sometimes required in cases of suits brought for compelling marriage or for damages, and court orders or writs of *de ventre inspiciendo* may need to be obeyed; sometimes, also, out of court, in cases of persons applying for charity to a corporation or trustees of charitable institutions. In neither of these latter cases is it likely that a witness will be required to make a vaginal examination, or to specialize by tact in any way, for there is no compulsion as in cases of the court. Nevertheless the physician may be consulted in such cases, and it will be expected that he is intelligent in such matters; if he is not, it will prove to his detriment."

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[1] Parvin: "Science and Art of Obstetrics," Philadelphia, 1886. This author quotes the following: "Overfed bitches, which admit the dog without fecundation following, are nevertheless observed to be sluggish about the time they should have whelped, and to bark as they do when their time is at hand, also to steal away the whelps of another bitch, to tend and lick them, and also to fight fiercely for them. Others have milk or colostrum, as it is called, in their teats, and are moreover subject to the diseases of those which have actually whelped" (Harvey on Conception).

Professor Haughton reported to the Dublin Obstetrical Society (February 7th, 1880), an interesting case of phantom tumor observed in an ass that had been covered by a zebra; the appearance of pregnancy deceived an expert.

[2] See Signs of Recent Delivery, p. 341

[3] "Text-Book of Medical Jurisprudence for Medical and Law Colleges," Cincinnati, 1885, p. 189.

ILLUSTRATIVE CASES OF FEIGNED PREGNANCY, LABOR, AND THE LYING-IN STATE.

1. *Metzlar, C.: Nederl. Tijdschr. v. Verlosk. en Gynaecol., Haarlem*, 1889, *i., pp.* 87–90.—Contribution to the knowledge of the origin of phantom tumors and nervous pregnancy.

2. *Nicoll, H. D.: Amer. Jour. Obstet., New York*, 1889, *xxii., pp.* 160–166.—A case of phantom pregnancy.

3. *Madden, T. M.: Amer. Jour. of Med. Sciences, Phila.*, 1890, N. S., c. 26–30.—On false pregnancy.

4. *Segur, G. C.: Amer. Jour. Obstet., New York*, 1890, *xxiii., pp.* 449–469.—The diagnosis of pregnancy.

5. *Cunningham, J. L.: Texas Courier-Rec. Med., Dallas*, 1890–91, *viii., pp.* 64–67.—Phantom tumor simulating pregnancy.

6. *Demange, E.: Mém. Soc. de Méd. de Nancy* (1888–89), 1890, *pp.* 34–37.—Milk secretion during a "nervous" pregnancy.

7. *Goodell, W.: Medical News, Phila.*, 1890, *lviii., pp.* 409–411.

8. *Wharton and Stillé, fourth edition, vol. iii., sec.* 37, quote the following case from *Henke's Zeitschrift, vol.* xliv., *p.* 172: "Dr. Albert relates that he was called upon to see a poor girl of twenty-two years of age in her last illness. In the presence of the physician and clergyman of the district she gave the following narrative and confession. Some eighteen months previously she entered the service of a married couple as housemaid.

"Her master, who was young and handsome, and assumed the title of baron, had no children. He succeeded, by tempting presents, in overcoming her virtue.

"He then represented to her that an important inheritance depended upon his having an heir; but having been married five years, and his wife proving unfruitful, he had no longer any hope of having children by her.

"He then proposed to the girl that in case she should prove with child, and would allow him to cause it to appear as his own legitimate offspring, he would not only give her a considerable sum of money, but would also let her remain in the house of her mistress, in order that she might always be near her child.

"She accepted the proposal, and as soon as she found herself to be pregnant the preparations were made to carry out the projected imposture. The girl remained in the house, living in the most retired manner, while her mistress played the part of a lady in an interesting condition. She introduced wool and folded napkins under her dress; and thus gradually let her rotundity become apparent, rubbing her breasts frequently in order to develop them, fainted in church, was often ailing, and sent for midwives and consulted them concerning her symptoms; physicians were also called upon, and every means taken to make public her happy expectations, so that no one had any suspicion that she was not pregnant. The traces of her monthly sicknesses were carefully concealed.

"The foregoing is a good illustration of the means carried out to simulate pregnancy; then follows the more difficult task of feigning labor and delivery.

"At last in due time the young girl fell in labor, which was allowed to advance considerably before the midwife was sent for.

"In the mean time the bed was arranged in the following manner. A board was taken out of the bottom of the bedstead, and immediately above this opening a hole was made through the mattress and paillasse, large enough to allow the legs of a person to pass through and rest upon the floor. The bed was made in such a manner as to sink down toward the headboard, while it was elevated below the opening in the mattress.

"The mistress now leaned in a sitting position, with her legs through the opening in the bed, and supported against the headboard, while the servant lay across her lap on a feather-bed, in the attitude of labor. Her body was entirely concealed by the bed-coverings, which also concealed her mistress up to the neck.

"The midwife, upon her arrival, found the baroness, as she supposed, in the throes of labor; she made the necessary examination, promised a speedy deliverance, and gave the usual words of comfort. The lady, however, screamed lustily at every pain, the approach of which she became conscious of by the involuntary contractions of the poor girl's body; while the latter suppressed her cries as much as possible, except when she could mingle them unperceived with those of her mistress.

"A living male child was soon born, and the after-birth followed it immediately. While the nurse was busy washing and dressing the child in another room, the girl escaped from the bed into an adjoining chamber.

"The baroness, before the return of the midwife, drew her feet up from the opening, covered it over with the bed, and stretching herself out upon it, forbade the midwife (who was desirous of ascertaining her condition) to touch her, except to wash off the blood with which she had previously soiled her thighs, declaring that she was in so much pain that she could not endure the slightest touch.

"The child was baptized, and on the second day put to the breast of the lady.

"As, however, very naturally, it found nothing there, the midwife was discharged, on the pretext that the baroness' own attendant could now take care of the child, which, immediately upon her departure, was confided to its own mother.

"The remainder of the girl's history, not being essential here, is omitted.

"Unexplained circumstances prevented the fraud from succeeding. The authors of the conspiracy fled, leaving the servant-girl sick and in a state of destitution. She died from the effects of privation and exposure, shortly after having made this confession."

9. *Madden, T. M.: Provincial Med. Jour., vol. xi., March,* 1892. —Spurious, feigned, and concealed pregnancy.

10. *Underhill, J. W.: Amer. Jour. Obstet., xi.,* 1878.—Feigned and false pregnancy; pseudo-cyesis.

11. *Madden, T. M.: Proc. Dublin Obstet. Soc.,* 1872–72, *xxxiv.,* 63–79 (reprint).—On spurious, feigned, and concealed pregnancy.

12. *Török, J.: Pest. Med. Chir. Presse, Budapest,* 1883, *xix.,* 1891. —Medico-legal case. Concealed pregnancy. Premature, difficult labor, provoked by unknown cause. Presentation said to be breech.

13. *Fischer, C.: Zeitschr. f. Wundärzte u. Geburtsh., Hegnach,* 1887, *xxxviii.,* 264–268.—Ein forensischer Pseudo-Geburtsfall.

14. *Hauck: St. Louis Weekly Med. Review, Jan.* 10, 1891.—In this case vomiting, peristalsis, and flatus, due to alcoholism, were supposed to be caused by the pregnant state.

15. *Haultain: Amer. Journ. Med. Sciences, Phila., April,* 1891. —Reports three cases of pseudo-cyesis. No cause could be found in the first; cancer of the uterus was the cause in the second; while a small fibroid in the uterine wall was the cause of the last. He attributes the origin of the condition to nervous influences, the phenomenon being simply a muscular distention of the abdomen. Some of the other signs are not so easily explained, but in nervous origin will usually be found the cause.

16. *Sligh, Physician and Surgeon, Detroit, U. S. A., vol. xv., No. II., p.* 61.—A case of spurious pregnancy and spurious labor. Mrs. B., American, primipara, 31 years of age, brunette, nervous temperament, and of average good health, in February, 1892, informed me that she had missed her monthly flow for the last two months, and asked if I thought she was pregnant. I replied that it would be difficult to determine positively at that time, and it would, therefore, be better to wait until such time as she could determine for herself. About the 1st of May following, an addition to her house was being built and the new portion being painted, at which time she wrote me a note saying she was not very sure that she was pregnant, and asked if the smell of fresh paint would do her any harm. On July 6th, 1892, I was sent for, and on arrival at her home, a few miles distant, I found her in bed, flowing slightly, with slight inter-

mittent pains, and somewhat nervous from fear of an impending miscarriage. She informed me that a few hours previously she had started to flow, the blood coming with a gush and in considerable quantity, and that she was about six months pregnant, she having felt motion for six weeks or more. With right hand I made a digital examination per vaginam, finding neck of womb about normal in size, but softer to the touch than in a non-pregnant uterus, and my left hand on her abdomen, which was noticeably larger than usual, felt plainly, as I supposed, motions of the fœtus. I said to her that from the condition of the neck of the womb she could not be more than four and one-half or five months pregnant, and that she must have been mistaken in her statement of having felt motion nearly two months. She reaffirming her statement in this regard, I made further examination per vaginam, finding the uterus enlarged antero-posteriorly, and attempted an examination through the abdominal walls by palpation, but owing to their extreme thickness, five or six inches at least, I could determine nothing definitely, except that fœtal motions were plainly felt. I did not further examine her, as from her statements at this time, and previously, I had no doubt of her being pregnant, but had examined her to the extent related, simply to arrive at some conclusion as to how far along she was. The flowing having about ceased, I prescribed an anodyne, with rest in bed, promising to see her next day, which I did, finding that her pains and flow had ceased, and she feeling quite cheerful.

On July 9th I was again sent for, and found about the same conditions as on July 6th. No examination was made at this visit, but a similar prescription as on July 6th wás left. On the evening of July 10th I was summoned in haste, and on my arrival found that an hour or two before, she had again commenced to flow, the blood coming with a gush and in considerable quantity, and pains occurring every three or four minutes, simulating labor pains. She informed me that motions of the child had been particularly strong that day, and she was very certain that a miscarriage must take place. I was also of that opinion, and having made up my mind that there was a placenta prævia, I thought it best to expedite matters, but found that I had in my obstetric bag only a light uterine dilator, and could not make full dilatation and deliver at once, as I wanted to, so I concluded to make a slight dilatation and tampon, trusting to the pains thus stimulated to complete the labor, which I at once proceeded to do, in addition thereto administering one drachm of fluid extract of ergot. Pains not increasing within an hour, I repeated the dose of ergot and went to bed, leaving instructions with the nurse to call me should the pains become notably stronger and more frequent, or should blood show through the vaginal tampon. I slept until morning, when I found the patient feeling well, the pains having stopped about an hour after I had retired. Upon removal of tampon the small amount of blood thereon showed that flowing must have ceased soon after its introduction. I was somewhat astonished at the unorthodox manner in which the case acted, but not enough so, as subsequent events proved, and returned to my office. When I arrived there I informed my assistant that I had discovered a new method of preventing miscarriage, namely, to dilate the neck of the uterus and tampon the vagina. Even now I did not suspect that she was not pregnant, with placenta prævia complicating. Before leaving her, I informed her that she had a placenta prævia, and advised immediate delivery, on account of the distance she was from any physician, but she declined this, being a Catholic, preferring to take the risk of her own life rather than possibly sacrifice that of the child.

Soon after this I went East, and did not see her again until November, 1892, when she informed me that about September 1st she went to a small town about five miles from her home, so as to be near a physician at her confinement; that at that time (September 1st) her breasts were large and milk came from the nipples; that soon after arriving at said town she had some pains and sent for a physician, who proceeded to make an examination, upon concluding which he informed her that she would be confined in ten or twelve days; at the expiration of the time he assured her she would be confined, pains came on, strong and regular, and the physician was again sent for, and after a prolonged examination, including introduction of sound into womb, he told her she was not pregnant. Soon after this she returned home, and the abdominal tumor subsided. At the present time she is fairly well, excepting an absence of menstruation probably due to her obesity, for which I am now treating her.

Here is a report of an interesting case of spurious pregnancy and spurious labor, the first I have met with in an experience of several hundreds of obstetrical cases, and I bring it to your notice, not in applause of my own acute powers of diagnosis, nor in an attempt to show that the true condition might not have been detected, had proper care been exercised on my part, but rather because of the rarity of such cases, and also as tending to prove the assertion at the beginning of this article, that "It is very hard to displace an impression once gained." It may also serve another purpose, namely, to put you on your guard against a similar mistake, and the subsequent mortification of hearing that some smart doctor, whose want of experience is equalled only by his want of knowledge, has been explaining to his friends that he, nor any other really good practitioner like himself, would ever be caught like that. Another feature of great interest in this connection is the fact that a sister of Mrs. B., who lives in Asia Minor with her husband, who is a practising physician there, went through a spurious pregnancy and spurious labor at the same time as did Mrs. B., with symptoms almost identically the same, placenta prævia being diagnosed by her husband in June, 1892, and neither of the sisters knew of the supposed pregnancy of the other until about the 1st of July, 1892.

A short time ago I requested Mrs. B. to give me a statement in writing of her supposed pregnancy, which she kindly consented to, and I herewith append a copy of her letter, omitting her residence and name :

COPY OF MRS. B.'S LETTER.

December 5, 1892.

DR. SLIGH, GRANITE, MONTANA :—The facts of my case are as follows : The last time I had my monthly period was the last of December a year ago. I missed it three times, when I consulted you as to whether I was in the family-way. You made no examination but said I could tell myself very soon. About the last of April or the first of May I felt a motion, and wrote you asking if it was safe to stay in a room where they were painting. I felt no doubt, as I was growing quite large and the motion was as distinct as with my first child. The first week in July I commenced flowing; it came in gushes, dark, almost black in color, and was quite profuse. I sent for you and by your advice went to bed and took medicine to stop the flow, with, however, no effect. You finally pronounced it placenta prævia; you then dilated the womb and gave me ergot to induce labor pains. The flowing ceased and no pains followed, so you concluded to do nothing further at that time. In a week I started flowing again, it lasting one week. I stayed in bed two weeks. After getting up I did not flow again. My breasts grew and secreted milk, and before subsiding my waist measured forty-two inches, twelve inches larger than natural. You then left and I went to a town situated in the vicinity to be near a doctor. There I felt well and had no trouble except something like labor pains ; the doctor thereupon made an examination and said I would be sick in ten or twelve days. At the end of that time I had severe pains. I sent for the doctor, who, upon examination, found I was not pregnant at all. The next morning I returned home, and in less than a week my waist measured thirty-four inches ; the milk left the breasts, and all other signs disappeared. My sister living in Turkey in Asia, and whose husband is a physician, had the very same experience at the very same time.

MRS. B.

3. SIGNS OF RECENT DELIVERY.

The questions of interest in this connection are:

What sign or signs render the diagnosis of a recent delivery positive?

How long after the emptying of the uterus can such a positive diagnosis be made?

The legal physician is required to render a decision, not only in the case of the living, but also in the dead must he from signs present state whether or no a recent expulsion of the contents of a pregnant uterus has taken place.

In the first instance (the case of the living) the decision is reached by the usual methods of diagnosis—inspection, palpation, percussion, and so on; in the case of the dead the value of an additional sign must be weighed and decided upon, namely, the corpus luteum.

a. **In the Living.**—As in the diagnosis of pregnancy, so in the determination of the existence of a recent delivery in the living, there are a large number of signs of greater or less value. We are able to place these signs in three classes indicative of their relative value.

There are several doubtful or uncertain signs that are of little value when standing alone, for they may even be found to be present in the male.

A second class of signs, uncertain still, we can for convenience term doubtful signs, and they, as in pregnancy, have to do with changes wrought in the external and internal genital organs of the woman.

Still a third class we have, constituting the sure or positive signs, and these are all founded upon the finding of the remains of an ovum in the genital tract.

1. UNCERTAIN SIGNS.—The skin of the anterior abdominal walls is examined, and there may or may not be changes present, according as the pregnancy has been well advanced or not.

If pregnancy terminated in the first third of its existence, little more than the usual slight pigmentation from pubes to umbilicus or ensiform appendix will be found, and this in blondes may be so slight as to escape notice.

Termination of pregnancy in the last third leaves a relaxed, wrinkled condition of the abdominal walls.

Œdema of the skin and old and new striæ[1] may or may not be present, according to circumstances. A varicose condition of the veins of the legs, with or without œdema, may also exist.

Even after abortion at the fourth month the slow puerperal pulse may be found.[2]

The usual subjective symptoms, as painful micturition,

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[1] Skin cracks, lineæ gravidarum.

[2] Vejas: Volkmann's "Sammlung klin. Vorträge."

"after-pains," thirst, burning pain in the genitals, pain in the breasts, profuse sweats, and a desire for sleep and quiet must be mentioned here.

The above uncertain symptoms prove nothing. They can exist in the male as well as in the female, in conditions other than that of the puerperal state.

2. PROBABLE SIGNS.—These include signs existing in the genital tract and in the mammary glands.

Inspection of the vulva discloses a swollen condition, perhaps some œdema, the pigmentation of pregnancy, a gaping of the labia majora and minora, the ostium vaginæ is dilated, the inner aspects of the labia may show lacerations, the fragments of the torn hymen and fourchette, more or less injury to the perineum.

In primiparæ all of the above conditions may be easily recognized; in multiparæ, all or most of them may be absent.

The vagina may show lacerations, congestion, œdema, and increase in secretion. The rugæ are absent, and its calibre is so much increased that the whole hand can be introduced.

We pass on to the cervix and we find it fissured, with the external and internal orifices allowing the introduction of one or more fingers. The internal os remains patulous so that one or more fingers may be passed through it, up to the eighth or ninth day of the puerperium.

An enlarged uterus is present, which may be felt above the pubis for about ten days following parturition.

"Upon the internal surface . . . the placental site may be felt for the first seven or eight days" (Winckel).[1]

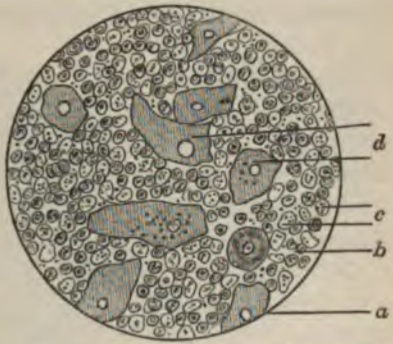

FIG. 52.—Lochial Discharge of the Second Day. A few isolated cocci and streptococci. Lochia cruenta. *d*, Epithelia; *c*, white blood-corpuscles; *b*, red blood-corpuscles; *a*, decidual cells. (Winckel.)

We find also the lochial discharge, which has its origin in the uterus, commences to flow immediately after the termination of labor, and continues with an average duration of from two to three weeks. The first two days this discharge is red (lochia rubra) and consists of fluid blood, blood clots, mucus, and pieces of decidua vera. About the third day it becomes sero-sanguineous, thinner in consistency (lochia serosa), and contains less blood and more mucus. Upon the seventh or eighth day it once more changes, is paler, thicker, more glairy in appearance (lochia alba).

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[1] *Loc. cit.*, p. 210.

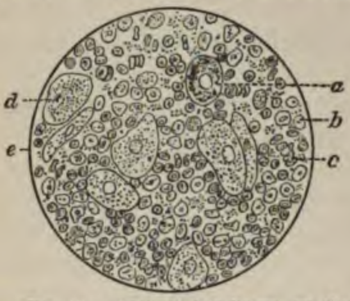

FIG. 53.—Lochial Discharge on the Fourth Day. *a*, Cells of the decidua; *b*, white blood-corpuscles; *c*, a few red blood-corpuscles; *d*, epithelial cells without nuclei from the vernix caseosa, with nuclei from the parturient canal; *e*, numerous clusters of cocci, partly in cells without nuclei, which are stained blue by Gram's method. × 330. (Winckel).

The mammary glands present the phenomena of pregnancy already referred to (see Diagnosis of Pregnancy). We notice the enlargement, the knotty feel, the pigmentation, striæ, swollen veins, areola, secondary areola, tubercles of Montgomery, and secretion. Colostrum (see Fig. 51, *a*) we obtain for the first seventy-two hours of the puerperium, and milk for the remainder (see Fig. 51, *b*).

These signs constitute what are termed the probable signs of a recent delivery. Standing alone, none of them offers positive proof; taken collectively, all or a major part justify us in making a positive diagnosis of the condition under consideration.

For example, the secretion of milk is a sign that pregnancy and labor have occurred, and yet it is a well-known fact that lacteal secretion may occur conditions independent of either gestation or parturition. It has even appeared in the male (see Diagnosis of Pregnancy).

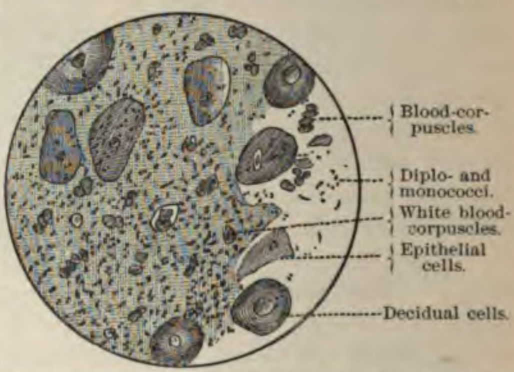

FIG. 54.—Lochia, Seventh Day. No elevation of temperature. (Winckel.)

The changes already described as occurring in the genital tract may all be simulated by various forms of inflammation, by lupus, malignant disease, and the passage of foreign bodies.

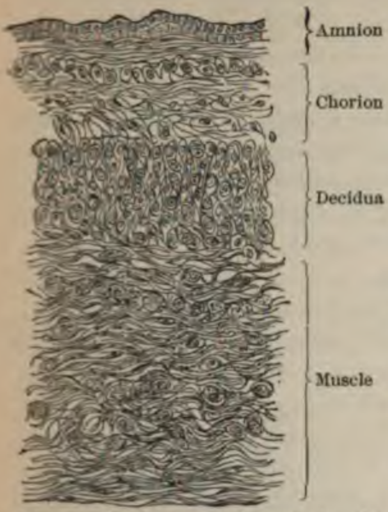

FIG. 55.—Membranes Adherent to the Uterine Wall. × 330. (Winckel.)

That there is a regularity or sequence about their onset, and that time causes certain well-understood changes in their appearance or condition, as the change from colostrum secretion to milk, the gradual diminution in size of the uterus, the changes in the lochial discharge, the rapid healing of lacerations, and so on—all these help us to form a positive diagnosis.

3. POSITIVE SIGNS.—"Positive proof of the occurrence of birth is only furnished by the discovery of parts of the ovum."[1]

If upon careful microscopic examination of the lochial discharges (see Figs. 52, 53, 54) we fail to find any evidences of remains of the ovum, we can with our finger or some appropriate instrument remove the remains of the placenta from the inner surface of the uterus, and can demonstrate the tissue found under the microscope, the diagnosis is fully established. "In most cases, the demonstration of shreds of the decidua with large nucleated and fatty cells, is of itself a sure proof" (Winckel). (See Figs. 55, 56, 57.)

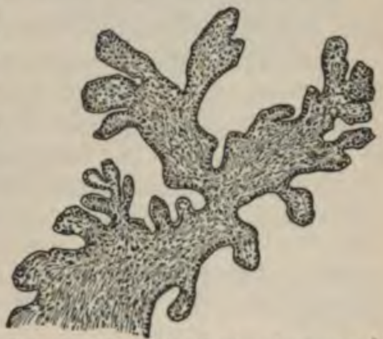

FIG. 56.—Villi of the Chorion (low power). (Winckel.)

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[1] Winckel. The same author narrates the case of a servant who sued her mistress because the latter accused her of having had intercourse with her husband. He (Winckel) extracted "a small piece of tissue about the size of a pea from the external os, and easily demonstrated the presence of very pretty chorionic villi, thus proving at once the oc-

How Long After the Emptying of the Uterus can a Positive Diagnosis of Recent Delivery be Made?—By means of the signs enumerated, diagnosis of the puerperal condition will rarely be found difficult within ten or fourteen days after parturition.

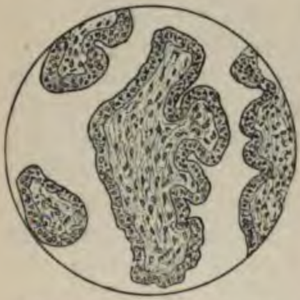

FIG. 57.—Villi of the Chorion. × 330. (Winckel.)

If the female has already borne children (multipara), the diagnosis cannot in some instances be positively established after the lapse of even a week or ten days.

If the case be one of a first labor (primipara), the character, intensity, and persistence of the signs present will permit a diagnosis to be made at a later date.

How Long a Period has Elapsed since Labor Terminated (Date of Delivery).—We are enabled to answer this question by carefully observing the character of the secretion from the breasts; the appearance and composition of the lochial discharge;[1] the height of the fundus uteri[2] in the abdominal or pelvic cavity; and particularly the *freshness* of the wounds that may exist in the genital tract.

b. **In the Dead.**—The diagnosis of recent delivery in the dead rarely presents any difficulty.

Many, if not all, the signs of recent delivery just enumerated as occurring in the living may be found in the dead, and in addition we are enabled to *see* the alterations that are present in the uterine body and its appendages.

The uterus immediately after labor weighs about twenty-four ounces; at the end of a week or ten days, about twelve

currence of cohabitation, conception, abortion, and destruction of the child."

[1] *Vide* pp. 343, 344.

[2] According to Dépaul, the height of the fundus of the uterus during the twelve days following labor at full term is as follows:

First day, one finger's breadth above the umbilicus.

Second day, on a level with the umbilicus.

Third day, a little below the umbilicus.

Fourth day, a little below the umbilicus.

Fifth and sixth days, two fingers' breadth below the umbilicus.

Seventh, eighth, and ninth days, three or four fingers' breadth above the pubic symphysis.

Tenth, eleventh, and twelfth days, at a level or a little below the pubic symphysis.

ounces; and by the end of five or six weeks has returned to its original size.

By about the ninth day after labor at term, if normal involution be present, the fundus of the uterus will be found behind the symphysis pubis.

The rate of return of the uterus to its normal size depends upon so many factors, as the period of gestation at which labor occurred, pathological conditions in the pelvis prior or subsequent to labor, the general condition of the woman, and so on, that any attempt to state positively from a post-mortem examination the exact date upon which parturition took place must be met with failure.

"The placental site, which is about the size of the palm of the hand immediately after birth, is about 3–4 cm. wide two weeks afterward and still somewhat uneven, due to projection of the thrombi from its surface. . . . Four to six weeks after labor the placental site may still be recognized, but is smooth and barely two-thirds of an inch, and the places formerly occupied by the vessels are now marked by yellow and black spots of pigmentation."[1]

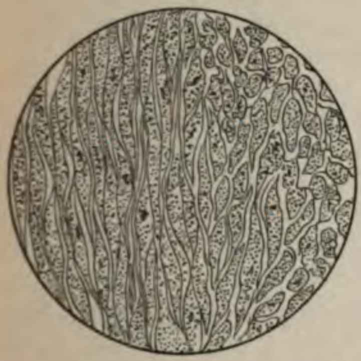

FIG. 58.—Muscle Fibres of the Puerperal Uterus. (Winckel.)

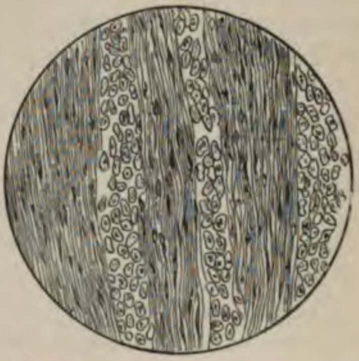

FIG. 59.—Muscle Fibres of the Gravid Uterus. (Winckel.)

The usual hyperæmia of pregnancy exists in the appendages of the uterus, but a few days suffice for this to disappear.

As to the signs of pregnancy revealed by a post-mortem examination: with the exception of those signs of pregnancy known as subjective signs, the remaining ones, known as objective ones, will in most cases be present. There are, however, two signs revealed by a post-mortem examination which have not yet been mentioned, viz.:

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[1] Winckel, *loc. cit.*

(*a*) THE FINDING OF AN OVUM, EMBRYO, OR FŒTUS WITH ITS ENVELOPES WITHIN THE UTERUS.—The gross appearances of the ovum, embryo and fœtus, in the several months of gestation we have already considered on pages 291–294, and of course this constitutes a certain sign. What concerns us here is the second sign, and in the light of modern research we can no longer, as formerly, term it a sure sign of gestation, but only a probable one. It is:

(*b*) THE PRESENCE IN ONE OR BOTH OVARIES OF A CORPUS LUTEUM VERUM, OR OF CORPORA LUTEA VERA.—After the Graafian follicle or ovisac ruptures and discharges the ovum, certain changes take place in the ruptured follicle which result in the formation of the corpus luteum.

It has been claimed by authorities upon the subject that these changes differ according to whether pregnancy does or does not ensue. Hence it has been customary to speak of a false corpus luteum, a corpus luteum of menstruation (corpus luteum spurium), when gestation does not follow; and a true corpus luteum, corpus luteum of pregnancy (corpus luteum verum), when the ovulation is followed by pregnancy.

It is generally agreed by authorities upon the subject that the following phenomena usually occur:

(1) If the ovum discharged does not become impregnated, hemorrhage into the Graafian follicle, together with proliferation of the membrana granulosa, hypertrophy, convolution, and vascularity of the follicular wall, and staining of the mass thus formed with yellow pigment, results at the end of about twenty-one days in a body three-quarters of an inch in length by half an inch in depth. This is the corpus luteum of menstruation. Contraction and retraction now set in, and by the end of seven or eight weeks a simple scar upon the ovary marks the site of the corpus luteum.

(2) If impregnation ensues after the rupture of the Graafian follicle, "the corpus luteum, instead of reaching its maximum of development at the end of three weeks, and afterward undergoing a rapid process of atrophy, continues to develop itself for

a considerable period, and does not, in fact, become decidedly retrograde until after the termination of pregnancy."[1]

The corpus luteum of pregnancy does not commence to diminish in size until about the fourth month.

"During the fourth month, the corpus luteum diminishes by nearly a third, and toward the end of the fifth month it is ordinarily reduced one-half. It still forms, however, during the first days after parturition, and in the greatest number of cases, a tubercle which has a diameter of not less than from $\frac{2}{7}$ to $\frac{1}{3}$ of an inch. The tubercle afterward diminishes quite rapidly; but it is nearly a month before it is reduced to the condition of a little, hardened nucleus, which persists more or less as the last vestige of a process so slow in arriving at its final term. Nevertheless, there is nothing absolute in the retrograde process of this phenomenon. I have seen women, dead at the sixth and even the eighth month of pregnancy, present corpora lutea as voluminous as others at the fourth month.

"Although it may not be, in general, that after parturition the corpora lutea disappear, it is nevertheless not without example that they disappear much more promptly. I have had the opportunity of examining the body of a woman, dead in the course of the eighth month of pregnancy, in whom the absorption was already complete. Facts of this kind are doubtless very rare, as only one has occurred in my observations, notwithstanding the numerous researches to which I have devoted myself for a long time. . . .

"There exists a notable difference between the corpora lutea which are formed as a sequence of conception, and those which occur aside from the conditions developed by impregnation. The duration of the former is much longer than that of the latter, and the volume becomes also much more considerable, although their nature is, in truth, identical. I have too often had occasion to remark this, in the ovaries of suicides, to retain the slightest doubt in this regard" (Coste).

What is the medico-legal value of the corpora lutea? Does the presence in the ovary of the so-called true corpus luteum indicate positively that pregnancy does exist or has recently existed?

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[1] Dalton: "Prize Essay on the Corpus Luteum of Menstruation and Pregnancy."

Modern investigation would seem to sustain the statement that no positive evidence is to be derived from either the false or the true corpora lutea. Instances are on record in which the so-called true corpus luteum has existed in the absence of pregnancy. (Cases 1, 2, 3, pp. 351, 352.)

Robinson[1] has studied the value of the corpus luteum verum and spurium, in the ovaries of women and animals, and comes to the conclusion that it is unjustifiable to elevate the corpus luteum to a medico-legal aspect in distinguishing pregnancy from non-pregnancy. He states that the yellow body may arise before rupture of the Graafian follicle and acquire its distinct convolution; and that the size of the follicle may be the same four months as sixteen months, or it may be a mere cicatrix two months after labor or even before. Hirst has shown that the so-called corpus luteum of pregnancy does not always indicate that impregnation has occurred.

He has pointed out that corpora lutea, identical with those of pregnancy, are found in the non-gravid female.

Again, pregnancy has existed where the so-called true corpus luteum has entirely disappeared before the completion of gestation. Coste describes a case where a woman died in the eighth month of pregnancy, and he found absorption of the corpus luteum complete. Finally, a ripe corpus luteum has been found in women neither pregnant nor menstruating.

Winckel says: "As regards the time that has elapsed since labor, the breasts, size of the uterus, the nature of its secretion and the *freshness* of the wounds present will aid in determining the point in question. In like manner the quantity and extent of the last-named conditions will determine the question as to whether the child was mature or born prematurely. On the other hand, it is not possible to establish the fact that twins have been born, in a woman who has been recently delivered. This question was put to me by one of our judges, and unless the placenta is still present, the possibility of such an occurrence must be admitted."

P. Dittrich[2] holds that a uterus not freshly puerperal will resist putrefaction longer than any other soft part of the body, and quotes cases.

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[1] North American Practitioner, Chicago, Jan., 1891.

[2] Prager med. Wochenschrift, 1890, xv., 249-252. Wiener med. Blätter, 1890, xiii., 340-358, in a paper entitled: "Contribution to the Diagnosis of Deliveries having Taken Place."

CASE I.—A body of a young girl was found in a river and examined just one year after death. Of all the soft parts the uterus alone was preserved, and only showed the beginning grayish-red color of putrefaction, and its size, shape, and consistency proved its virginal character, the girl having been suspected of an abortion.

CASE II.—A young girl disappears; abortion and homicide are suspected; nine months later the body of the girl is found in a privy vault; the autopsy reveals the uterus alone preserved, and it is hard, a light red color, of virginal size quite recognizable, and its cavity quite normal, empty, and virginal, thus establishing the fact that she had not been killed because of pregnancy.

ILLUSTRATIVE CASES OF THE DIAGNOSIS OF DELIVERY.

1. *Hofe, J. W.: Virginia Med. Monthly, Richmond*, 1890–91, *xvii.*, 540–542.—Delivery of a normal placenta a year after abortion.

2. *Egan, P. B.: Med. Record, New York*, 1890, *xxxviii.*, 457. —Rupture of the membranes twenty-five days before the birth of a healthy child.

3. *Winchester, W. R.: Virginia Med. Monthly, Richmond*, 1890–91, *xvii.*, 26.—Bloodless labor.

4. *Meadows, A.: Trans. Obstet. Soc. London* (1875), 1886, *xvii.*, 355; 1876, 1877, *xviii.*, 69.—Note on the post-mortem diagnosis of a nulliparous uterus.

5. *Leonard, T. K.: Atlanta M. and S. Journal*, 1889–90, *N. S.*, *vi.*, 697.—An unusual case; labor with not a drop of blood lost either before or after the birth of the child. (The authenticity of this case depends upon the statements of a clergyman and his wife, who were certain not a drop of blood was lost during labor, not even after the expulsion of the placenta. The mother was very anæmic; the child, a boy, lived.)

6. *Heaton: Obstet. Gaz., Cincin.*, 1878–79, *i.*, 317.—Post-mortem indications of pregnancy.

ILLUSTRATIVE CASES OF THE CORPORA LUTEA.

1. *Benham, W. T.: Edinburgh Med. Jour., Aug.*, 1873 (quoted by Wharton and Stillé).—A young woman was confined for a number of years in a lunatic asylum. Death ensued, and a post-mortem examination presented signs of virginity, and a highly developed corpus luteum in one ovary. Impregnation was absolutely impossible in the case; and moreover the minute ovum of ovulation was actually detected within

the uterine cavity, thus proving beyond a doubt that the development of the corpus luteum did in no way depend upon the growth of the ovum.

2. *Popow, W. A.: London Lancet, May* 27th, 1882 (quoted by Tidy).—A prostitute 21 years old died from prussic-acid poisoning. At the post-mortem examination a fully ripe corpus luteum was found in the ovary, although at the time of death she was neither pregnant nor menstruating.

3. *Popow, W. A.: London Lancet, May* 27th, 1882 (quoted by Tidy).—A female, age 41 years, died from gangrene of a uterine fibromyoma. No pregnancy existed. One ovary contained a true corpus luteum which resembled that found in pregnancy.

III. SUPERFŒTATION.

By the term **superfœtation** is meant impregnation when an embryo already occupies the uterus, or the fertilization of a second ovum after the development of the first ovum has been going on in the uterus for a month or more. Two results may follow:

(1) Two children are born at the same time, but differing in development; or—

(2) Two children are born at different times, equally developed.

By the term **superfecundation** is meant the impregnation of one or more ovules after one has already been impregnated, or the fertilization of one or more ova of the same ovulation at a second coitus, after one has already been fecundated—"successive instead of simultaneous fecundation" (Parvin). The result of superfecundation is simply multiple pregnancy, but the children may or may not differ according as they possess the same or different fathers.

The term **superimpregnation** explains itself.

If all the above conditions are possible, we may have as the result of superfecundation—

1. The birth of twins or triplets with certain physical peculiarities proving that they have had different fathers.

And as the result of superfœtation—

2. The birth of children at the same time, differing in the degree of their development; or—

3. After the birth of a mature child, a second one, equally developed, may be born after a lapse of several weeks or months.

That superfecundation may occur in both woman and the lower animals is now a matter of certainty.

A mare is covered by a stallion, and after an interval of several days is covered by an ass; the result is twins—one a horse, the other a mule (Mende).

A setter bitch during the same ovulation (heat) is covered successively by a pointer and a mastiff; her puppies plainly indicate the different fathers.

Medical literature supplies abundant cases to illustrate superfecundation in woman.

For superfœtation to be possible, the occurrence of ovulation is required several weeks or months after the fertilization of the first ovum.

The physiological law in woman is for ovulation to cease as soon as impregnation takes place. Nature seemingly intended woman to be uniparous, although we see the exceptions in multiple pregnancy.

The believers in superfœtation lay stress upon the fact that because women apparently menstruate for one or more periods during pregnancy, therefore ovulation occurs at the same time.

Playfair cites the presence of menstruation as a proof of ovulation.

As has been already pointed out in this article, the presence of menstruation is no proof that ovulation is also present (see Duration of Pregnancy).

We have absolute proof that what is apparently menstruation does in certain rare instances continue for one, two, three, or even the nine months of gestation.[1]

We have at the present stage of our knowledge no absolute proof that ovulation accompanies these apparent menstrual epochs occurring during the period of pregnancy. Certainly we have no valid ground for denying that ovulation does thus in some instances occur.

Superfœtation proper, then, according to our definition, is possible—it is even probable. That it certainly occurs the present state of our knowledge does not permit us to state.

Cases of apparent superfœtation may be explained in other ways.

Twins are born together. One is apparently fully developed and the second one shows a decided lack of development, so that the second fœtus may be thought to be the result of superfœtation. A possible explanation is that the second twin failed to secure its proper supply of nourishment during intra-uterine life,[1] and slow development occurred.

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[1] Any recent obstetric authority may be consulted.

In the case of triplets, two may die, and the third go on to complete development.[2]

In cases of twins where the less developed fœtus is dead at birth, we may look upon the phenomenon as simply that of a blighted ovum retained without decomposition.

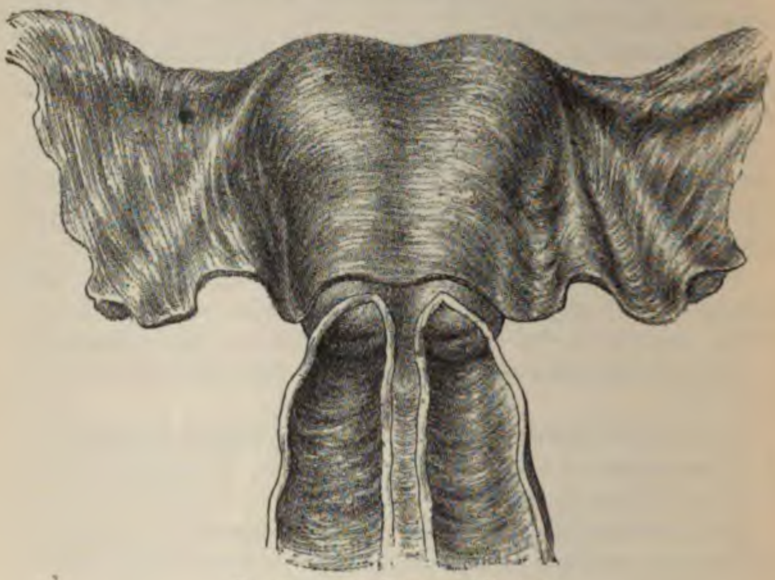

FIG. 60.—Double Uterus and Vagina.

Two well and equally developed children are born within an interval of several weeks or months of one another. These are the cases that are held out as examples of superfœtation. The phenomenon may be explained by the presence of a double uterus, or a uterus septus.[3] (Figs. 60, 61.)

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[1] Winckel: "Text-Book of Midwifery," Phila., 1890, p. 119. Budin: Comptes rendus de la Soc. de Biol., 1883, Nov. 11. Galabin: "Manual of Midwifery," Phila., 1886, p. 227.

[2] Bock: Inaug. Dissert., Marburg, 1855.

[3] A case of this kind with double uterus may be found in a paper by Dr. Ross: Lancet, Aug., 1871.

The most difficult cases to explain on other grounds than those of superfœtation are those in which viable children have been born at an interval of *four months*. Such cases are on record,[1] and offer the strongest evidence in favor of the occurrence of superfœtation.

The best proof, however, that these cases are not due to superfœtation is that in five-sevenths of the number there is but a single placenta.[2]

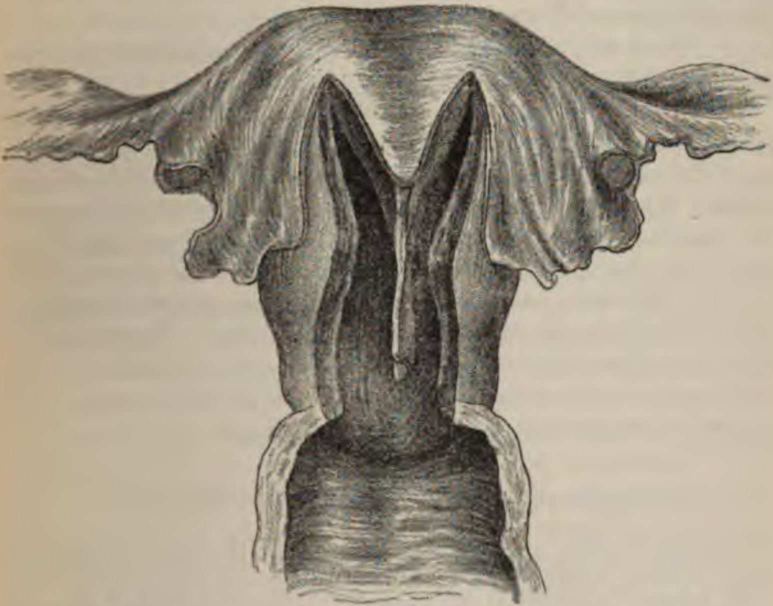

FIG. 61.—Uterine Cavity Divided by a Septum, the Neck of the Uterus and the Vagina Being Single.

The existence of pregnancy upon one side of a divided uterus teaches by experience that a decidua usually forms upon the other side.

There is nothing to prevent superfœtation occurring at almost any time of gestation, provided ovulation be present.

There are cases on record that were first thought to be those of superfœtation, but in which the presence of a double uterus was subsequently demonstrated.[1]

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[1] "A Critical Inquiry regarding Superfœtation, with Cases." Dr. Bonnar: Edin. Med. Jour., Jan., 1865.

[2] Auvard: Archives de Tocol., April, 1883.

We are unable to state in how many of the cases of apparent superfœtation one or other of the above conditions existed.

CONCLUSIONS.

1. Superfœtation has in many instances been assumed without sufficient evidence.[2]

2. There are cases on record that we are unable to explain on any other ground than that of superfœtation.

3. Whether in all the cases of apparent superfœtation the uterus was normal is not definitely known.

"The result of all the observations made upon this subject is, that the majority of the alleged cases of superfœtation may be explained (1) upon the theory of twin pregnancies, where one fœtus has grown at the expense of the other, and is first expelled, the other remaining until it has acquired the proper maturity; (2) by the existence of a double uterus. Nevertheless, there are a few other cases which do not admit either of these explanations, and which cannot be accounted for except on the theory of two successive conceptions" (Reese).

ILLUSTRATIVE CASES OF SUPERFŒTATION.

1. *Way, E. W.: Australasian Med. Gaz., Sydney*, 1889–90, *ix.*, 166.—Notes on a case of superfœtation; uterine and extra-uterine.

2. *Althen: Centralbl. für Gynäk., Leipzig*, 1890, *xiv.*, 711–713. —Case of pregnancy in both compartments of a double uterus.

3. *Branch, F. S.: New Orleans Med. and Surg. Jour.*, 1890–91, *xviii.*, 189–191.

4. *Bonnar: Edinb. Med. Jour., Jan.*, 1865.—Cites cases to prove the occurrence of superfœtation, and "cases that prove, as far as anything of the sort can prove, that superfœtation is a positive fact."

IV. THE PERIOD THAT MUST ELAPSE AFTER DELIVERY BEFORE THE WOMAN CAN AGAIN BECOME PREGNANT.

How soon after delivery can a woman again be impregnated and become pregnant?

G. L. Bonnar, in his "Critical Inquiry regarding Superfœtation, with Cases,"[1] referred to elsewhere, reached some interesting conclusions in regard to this question. Not being satisfied with the then generally accepted opinion that a month must elapse between the termination of labor and a fresh conception, he undertook an investigation into what was known as "Hodge's Peerage and Baronetage." His results were as follows: In at least nineteen cases, the interval between one birth and another was less than 309 days. In ten cases the interval varied from 309 to 300 days, in two from 299 to 290, in four from 289 to 280, in one it was 273, in another 252, in another 182, another 173, and in one 127 days.

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[1] See case of Dr. Ross.

[2] Galabin: *Loc. cit.*

Taking these cases in consideration, as well as the post-partum conditions of the uterus, lochia, and vagina, Dr. Bonnar placed the earliest date after confinement, when the woman could again become pregnant, as the fourteenth day.

Leopold's observations appear to prove that the repair of the uterine mucous membrane after confinement is not complete earlier than the end of the fourth week; that the red and yellow lochia cease the beginning of the second week, and that the white lochia continue until the sixth week.

Observations would tend to indicate that one-half of those women who do not nurse their children, and also those women who menstruate during the period of lactation, have their first post-partum menstrual period (and hence ovulation and capability of impregnation) within six weeks after confinement.

Concerning conception during the lying-in state, Krönig[2] described before the Gesellschaft für Geburtshülfe zu Leipzig the case of a IIpara, delivered in the Leipziger Frauenklinic, who had conceived on the fourth day following the delivery of her first child. She was twenty-two years old when delivered of a healthy child. Four days later she was subjected to coitus. Following this was three months' abstinence from intercourse. At four and a half months from the coitus the movements of the fœtus were observed, and on the 243d day labor occurred. The child, having every appearance of being at full term, measured 52 cm. and weighed 3,550 grams. After a careful study of the case, Krönig arrived at the following conclusions:

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[1] Edinb. Med. Jour., Jan., 1865.

[2] Centralblatt für Gynäkologie, No. 19, 1893, and Univ. Med. Jour., August, 1893.

1. A fully developed child may be born after a period of pregnancy lasting 243 days.

2. The spermatozoön retains its vitality in the lochial secretion.

3. The ovarian activity does not entirely cease during pregnancy. The follicles ripen, and may rupture very soon after labor.

4. Menstruation and ovulation may occur independently.

5. In strong individuals there may be a rapid regeneration of the mucous membrane, rendering possible the attachment of an impregnated ovule in the earliest period of the puerperal state.

V. UNCONSCIOUS IMPREGNATION, PREGNANCY, AND DELIVERY.

1. Unconscious Impregnation.

Can a woman become pregnant in a state of unconsciousness? The answer is in the affirmative.

In cases of rape that are upon record, young girls have been impregnated while under the influence of some narcotic, or the anæsthetics such as ether and chloroform. That pregnancy may take place following intercourse under such conditions, all authorities upon the subject are agreed.

Artificial impregnation, where the seminal fluid has with suitable instruments been injected directly into the uterus, has also been successfully performed.

"That a woman should be unconscious both of the fact of sexual intercourse, and also continue unconscious of the resulting pregnancy up to the birth of her child, we decline to believe, unless she was feeble-minded or idiotic.

"Cases of this character frequently occur in unmarried females, who are wont to protest most earnestly their utter ignorance of the whole affair, and who pretend to ascribe the pangs of labor to colic or some other disorder; and who, when the child is shown them, will positively deny all knowledge of its origin" (Reese).

Upon unconscious conception and pregnancy T. Kost,[1] says: "Questions sometimes come up as to the possibility of a woman becoming pregnant unconsciously, and the judgment of a physician may be required on this point. Referring to this question then, as to the probable or possible facts, the answer is that such an occurrence is exceedingly improbable but is yet possible.

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[1] "Text-book on Medical Jurisprudence for Medical and Law Colleges," Cincinnati, 1885, p. 189.

"Conception is not, in a physiological sense, a voluntary act; the conditions afforded are one thing, and the conception another, so the will or the consciousness, physiologically, is not a factor in the premises. Let the conditions once exist, then the physiological act is involuntary and takes place unconsciously. Some females have declared that they were conscious of the act of conception; but perhaps such averments are not in place. They can carry no further assurance than the moral question of veracity, since no descriptions of said sensations can afford a definition.

"The averment that it is easier or 'better felt than told' is not one that is of competency in a court, when it applies to a second party or concerns another person. The truth is, that conception itself is a physiological function independent of the will.

"Still the question returns, can the act necessarily antecedent to conception take place without the knowledge of the female? This may be answered in the affirmative. Instances are on record where females have been drugged, intoxicated, or otherwise made unconscious, and who have then been made victims of lusts.

"The question has also been put to physicians as to the possibility of a sleep being sufficiently sound to allow the unconscious occurrence of the act necessary for conception. Although, in the matter of sleep, like all other human affairs, there is hardly a limit to variety, we still could not say certainly what the possibilities are; but it may be safe to say, that in natural sleep such an event could not occur unconsciously. There may be congestion of the brain by overheating, over-excitement, or from certain diseases, so that it may become so oppressed as to produce catalepsy or a deep somnolency, that might admit of almost any ordinary force upon the body without mental consciousness thereof."

Can copulation and impregnation occur in a woman without her knowledge, during hypnotic sleep?

Brouardel,[1] who has studied and written upon this subject, states that under certain favorable conditions a woman can be ravished without her knowledge during hypnotic sleep.

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[1] Gaz. des Hôpitaux, 1877.

If the suggestions offered to the somnambulist are acceptable or of an indifferent character, and not offensive, if the man himself is agreeable, then she submits herself to them; on the other hand, if the suggestions are revolting to her personal affections or her natural instincts, she opposes to them a resistance which is almost insuperable.[1]

"One may easily lead the hypnotized subject, for example, to sign a receipt for money, but if she has preserved her normal chaste instincts, anything opposed to those instincts will be sought in vain. But, on the contrary, if the sentiments and the acts offered by the magnetizer to his subject correspond with her own, she obeys readily his suggestions. In the great majority of cases, however, a woman does not recall in her waking state what happened to her in the state of somnambulism, or *vice versa;* yet the same feelings affect her in both states.[2]

Brouardel[3] experimented as follows:

"A young woman was hypnotized, first by pressure on a suggested hypnotic point and then by slight friction on the forehead.

"Brouardel then approached her and asked her if she would accept a loan of fifty francs. At first she refused; but on the suggestion being forced upon her, she gradually weakened and finally consented to accept the offer. A stamped receipt was then drawn up with every possible legal precaution, and the patient herself was quite anxious there should be no mistake about it. She then signed it and Brouardel put it in his pocket, but did not offer to give her the money. She was then awakened and acknowledged the receipt was signed by her, but could not remember under what circumstances she had been induced to sign it, or whether or not she had received the money. Legally the receipt was entirely valid, and the holder of it could collect payment for the loan."

ILLUSTRATIVE CASES OF UNCONSCIOUS IMPREGNATION.

1. *Sippel, A.: Centralbl. f. Gynaek., Leipzig,* 1881, *v.*, 202.—Conception without *immissio penis.*

2. *Med. Counsellor, Columbus,* 1855, *i.*, 423.—A case of impregnation without knowledge of the fact on the part of the female.

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[1] F. W. Draper in Sajous' Annual, 1887. [2] *Loc. cit.* [3] *Loc. cit.*

3. *Braun, K.: Wien. med. Wochenschr.*, 1872, *xxii.*, 1121–1125. —On conception without perforation of the hymen and with positive impossibility of *immissio penis.*

4. *Börleben: Vierteljschr. f. gerichtl. u. öff. Med., Berlin*, 1885, *vii.*, 93–98.—Fecundation without *immissio membri.*

5. *Capuron: Méd. Lég. des Accouchements, p.* 86, mentions a case in which the fact of pregnancy was first ascertained at the end of the fourth month, by the woman having complained to one of her sisters of a strange sensation which she experienced in the lower part of her abdomen (quoted by Taylor).

2. UNCONSCIOUS PREGNANCY.

As is well known, it is not only possible but quite common for women to become pregnant, and remain so for some time before they become aware of their condition. This applies more particularly if not exclusively to the married females.

In the unmarried, in spite of their serious protestations of their entire ignorance of all concerning the matter in question, unconscious impregnation and pregnancy is a rare condition.

Many cases may be furnished, on the other hand, of married women, especially those childless for a number of years, who finally really do become pregnant, and then refuse to believe the medical attendant when assured that such is the case, believing their altered condition to be due to some disease.

"When a woman is impregnated in a lethargic state, it is unlikely that she should go beyond the sixth month without being fully aware of her pregnancy; and if her motives were innocent, she would undoubtedly make some communication to her friends."[1]

It must be borne in mind, however, that it is possible for a woman to carry her child to full-term, and be unconscious of the fact of pregnancy.[2]

"Instances of this kind are important in reference to alleged unconscious delivery in women charged with infanticide.

"At the same time, all cases in which there are motives for pleading unconscious intercourse or pregnancy require close examination; they will frequently be found to be quite unworthy of belief. This remark especially applies to unmarried women who often consult a medical man on their condition with full knowledge that they have exposed themselves to the chances of pregnancy. Up to the time at which the fœtal movements are perceptible a woman may honestly attribute her condition to other causes. Dating from the middle period of pregnancy, however, she must be aware of her state, but she endeavors to dissemble this even to herself" (Taylor).

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[1] Taylor.

[2] See Tanner: London Obstet. Trans., vol. iv., p. 113, also London Lancet, 1861, i., pp. 609–643.

ILLUSTRATIVE CASES OF UNCONSCIOUS PREGNANCY.

1. Upon unconscious and concealed pregnancy, *Casper (Forensic Medicine, New Sydenham Society, London,* 1864, *vol. iii., p.* 378), says:

"Like every other medical man, I have in the course of my practice seen married women, who from large experience were very well acquainted with the signs and effects of pregnancy, and who had no desire to have such matrimonial blessings continually renewed, incredulous, for a hundred reasons, as to their state, up to the very last month of their new pregnancy, and prepared with a plausible explanation for each fresh symptom. In one case conception had occurred during suckling, which the woman incorrectly held to be impossible; at another time, the new pregnancy happened when it had long ceased to be dreaded, after a pause of many years—after so many as thirteen years in one of my own cases. The signs of pregnancy are obscured by the coexistence of disease; and then the intercourse in question is regarded as 'impossible' to have impregnated, and in this matter the most experienced matron is just as liable to error as the most inexperienced maid; while, at still other times, important irregularities in the catamenia have disturbed the reckoning, etc. Numerous cases of this nature are recorded in the literature of this subject. But in all such cases pregnancy *bonâ fide* existed, and it is credible that a young girl of sixteen should quite innocently carry about her distended abdomen, because, as she finally confessed, 'the Baron H., who had conducted her home from a ball, and had been with her only once, had solemnly assured her that the first time never had any result.'

(Gadermann, in Henke's *Zeitschrift*, 1846, 3, 5, 87.)

"But all ingenuousness ceases the instant the case becomes a judicial one, a case where different interests clash, and the forensic physician is engaged with it. For the most experienced, as well as the most inexperienced, will speak *mala fide* when in defence of her interests she declares that she knows not, or at least pretends not to know, that she even only once has exposed herself to causes of pregnancy. In the course of the precognitions in the criminal or civil case, ay, even from the mere consideration of judicial observation being continually directed to the condition of her body, the sum of the remarkable alterations in her corporeal state during the progress of pregnancy must become known to her in their true signification, and remembering the *ante acta*, the belief of the possibility of a pregnancy must more and more force upon her the conviction of its actual existence. The former Prussian statutes, therefore, were not unjustifiably harsh in denying that a woman after completion of the thirtieth week of her pregnancy could be any longer ignorant of her condition, and the forensic physician will in most cases not err, and will be able to answer on his conscience, when he assumes that ~~at least~~ during the last third of its continuance pregnancy is no longer unconscious—that is, that the concealment of it is not unintentional. The only possible exceptions to this may be where there is no recollection of any act of impregnation; that is, those rare instances of impregnation during a state of unconsciousness (p. 298, Vol. III.) or in feeble-minded or idiotic women. And as, in every matter, individual cases occur in medico-legal practice of such anomalous constitution as to constitute an exception to the general rule—so, also in relation to this subject, there may be a concurrence of circumstances in favor of the pregnant woman. Thus, in a case which, many years ago, was the occasion of *superarbitrium* by the 'Scientific Commission,' a young and very weak-minded girl was alleged to have concealed her pregnancy up to the time of delivery unintentionally because it was unknown. The reasons which induced the Superior Medical Board to regard her assertion as justified were as follows: the girl was constantly assured by her seducer 'that he had not come near enough to her to make her pregnant;' that as a primipara she had no experience in this matter; that it was proved that she had caught a violent cold while standing in a river washing; that she had blamed this cold for the cessation of her menses, which occurred shortly after, and for the enlargement of her body, etc.; and finally, that the surgeon to whom she had applied on account of this completely confirmed her opinion, and continued to give her remedies to bring back her catamenia. I think, therefore, that the forensic physician will have no difficulty in any case in deciding this question, which is of by no means so frequent occurrence as formerly."

2. *Rüttel: Henke, Zeitschrift der S. A.*, 1844, *p.* 264, mentions the case of a woman, age 41, who had been married upward of sixteen years, and who, while returning from a neighboring village, was suddenly delivered of her first child, when only a few days before she had been complaining that she was not likely to have any children. The child was mature and lived. (Quoted by Taylor.)

3. *Long: Med. Times and Gaz.*, 1857, *i.*, *p.* 592, reports a case in which a married woman, age 24, subject to irregular menstruation, consulted him for an attack of spasms. On his arrival he found that she had suddenly given birth to a seven-months' child. Neither her husband nor herself had the slightest idea that she was pregnant. She had

noticed that she had become somewhat stout, and that her breasts were more full than natural. She had attributed her condition to improved health, and the cessation of the menstrual discharge was set down to some accidental cause. (Quoted by Taylor.)

4. *Lond. Med. Gaz., vol. xxxix., p.* 212.—A young woman who had intercourse knowingly was supposed not to have been aware of her pregnancy until the seventh month; but there is reason to believe that this woman was guilty of deception. (Quoted by Taylor.)

5. *London Lancet*, 1860, *i., pp.* 609–643.—Cases of unconscious pregnancy in married women.

6. *Tanner: London Obstet. Trans., vol. iv., p.* 113.—A married woman who had not had a child for a period of nineteen years, found herself, as she thought, getting unusually stout. She was moving about with her family from place to place. At last her size alarmed her, and she thought she was suffering from dropsy. She consulted a physician who informed her that she was in an advanced stage of pregnancy. She treated his opinion with great contempt. In travelling with her daughter she arrived at a miserable inn, and on the night of her arrival this lady was seized with labor pains, and was delivered of a child. No preparations had been made for the birth, and up to the onset of pains she had not, with all her former experience, the slightest idea that she was pregnant. (Quoted by Taylor.)

3. Unconscious Delivery.

Is it possible for a woman to be delivered in a state of unconsciousness?

We find Tidy making the following answer to this question:

"Both published cases and the author's experience oblige an answer in the affirmative. These cases are, however, very rare, and the woman could scarcely be long ignorant that something unusual had happened, unless she were the subject of puerperal mania, or of some other form of insanity."

The possibility of unconscious delivery is especially important in regard to the subject of infanticide; the plea being that the woman was unconscious of the act of parturition.

That women may be unconsciously delivered while under the influence of narcotic poisons—*e.g.*, the vapors of chloroform, ether, or intoxicating liquors, while suffering from some form of coma, asphyxia, syncope, or in the act of dying, there is no doubt.

Cases are appended where women have been delivered unconsciously during profound sleep.

An attack of hysteria is another condition in which a woman may be confined without her being conscious of the fact.

In the two latter conditions, however, unless profound and deep, it is more than likely that the pains of the expulsive stage of labor would arouse the woman.

This is especially true of primiparæ, namely, those bearing their first child. Every obstetrician, however, is aware that in some women, particularly old multiparæ with roomy pelves and relaxed soft parts, a very few and almost painless contractions of the uterus are sufficient to rapidly and easily empty the womb.

Perhaps the most frequent diseased condition in which a woman may be unconsciously delivered is the stupor, convulsions, or coma of puerperal eclampsia. As is well known, puerperal mania often follows this condition.

Under the preceding conditions it is quite possible for a woman to be confined, injure or even kill her child, subsequently to be restored to consciousness, and be perfectly truthful in her assertion of her entire ignorance of what had happened.

Of course the clinical picture of puerperal albuminuria or eclampsia would sustain her statements.

Among the illustrative cases appended will be found those where the expulsion of the child was mistaken for a strong desire on the part of the woman to empty her bowels.

This is a common defence set up for the charge of child-murder.

An intense desire to empty the lower bowel accompanies the expulsive stage of labor, and from our present knowledge of the subject gleaned from many cases reported by competent observers, a woman may be seized with this intense desire to defecate, hurriedly enter a water-closet or privy, and be absolutely ignorant of the act of parturition, until too late to save the expelled child from injury.

Such accidents are possible and have happened. Before such an occurrence is accepted in a given case, a thorough investigation should be made by the medical witness, including a vaginal examination of the woman in question.

In addition we must bear in mind that while the woman may in a given case be unconscious of the expulsion of her child at the moment of delivery, yet she cannot remain ignorant of the fact that she has been delivered, if she be at the time conscious.

ILLUSTRATIVE CASES OF UNCONSCIOUS DELIVERY.

1. *Weill: Gaz. Méd. de Strassburg*, 1881, 3, 1, *x.*, 103.—Observations of a woman who was delivered during sleep.

2. *Spiegelthal: Mag. f. d. ges. Heilk., Berlin*, 1825, *xx.*, 183.—Delivery without the consciousness of the parturient woman.

3. *Smith, G.: Edinburgh Med. Journal*, 1862, 3, *viii.*, 477.—Case of unconscious delivery.

4. *Shortt, J.: Trans. Obstet. Soc., London*, 1863, *iv.*, 210.—Case of unconscious and sudden delivery.

5. *Case, M. W., Amer. Journ. Med. Sciences, Phila.*, 1886, *lv.*, 279.—Labor during sleep.

6. *Amiss, N. Y. Med. Press*, 1859 N. S. II., 773.—Unconscious delivery.

7. *Albert: Ztschr. f. d. Staatsarznk., Erlangen*, 1830, 13, *Ergnzngshft.*, 284–301.—Labor without pain.

8. *Fox, D. D.: Trans. Louisiana Med. Soc., New Orleans*, 1888, 209–211.—A woman who has had eight children completes her full term of utero-gestation without being aware that she is pregnant.

9. *Berthier: Ann. Soc. de Méd. de Lyon*, 1859, *vii.*, 66–69.—Melancholia and delirium produced by a pregnancy unsuspected by all, including the patient. The pregnancy terminated in a labor without the knowledge of the patient.

10. *Genth N.: Ztschr. f. Geburtsk., Berlin*, 1848, *xxiv.*, 77.—Unconscious delivery in the case of a healthy woman.

11. *King, H. G.: Med. Times, London*, 1847, *xvi.*, 234.—Birth of a child without the knowledge of the mother.

12. *Palfrey, J.: Lancet, London*, 1864, *i.*, 36.—Twin labor in which uterine action commenced and progressed to the second stage during sleep.

13. *Samelson, A.: Brit. Med. Journ., London*, 1865, *ii.*, 550.—Delivery during sleep.

14. *Verrier: Journ. de Méd. de Paris*, 1890, *ii.*, 309–312.—De l'hypnotisme pendant le travail de l'accouchement.

15. *Blanckmeister: Monatssch. f. Geburtskund. u. Frauenkr., Berl.*, 1854, *iii.*, 13–15.—Case of painless labor.

16. *Cripps, F.: Lancet, London*, 1841–42, *ii.*, 367.—Absence of pain in parturition.

17. *Colton, R., Jr.: Med. Bull., Phila.*, 1879, *i.*, 68.—A painless labor.

18. *Davis, J. W.: Nashville Journ. Med. and Surg.*, 1881, *xxvii.*, 252.—Several cases in midwifery illustrating the absence of pain in labor.

19. *Depaul: Journ. des Sages-Femmes, Paris*, 1882, *x.*, 9.—Femme

tombée sur le voise publique et ayant accouché pendant une syncope qui a devié quatre heures ; enfant vivant.

20. *Murray: Med. and Surg. Sep., Phila.*, 1877, *xxxvii.*, 69.—Painless labor.

21. *Clay, C.: Lancet, London*, 1841–42, *ii.*, 404–407.—On the prevalence of almost unconscious parturition in manufacturing districts, with remarks on unconscious conception and parturition.

22. *Badger, W.: Med. Rec., N. Y.*, 1879, *xvi.*, 600.—Painless labor.

23. *Anderson, R. B.: South. Med. Rec., Atlanta*, 1879, *ix.*, 86.—Childbirth without pain.

24. *Fanton: Marseilles Méd.*, 1889, *xxvi.*, 660-665.—Arch. de Tocol., Paris, 1890, xvii., 104–108.

25. *Hite, C. E.: Cincin. Med. News*, 1873, *ii.*, 260.—Case of painless labor.

26. *Gillette: Amer. Journ. Obst., N. Y.*, 1879, *xii.*, 329.—Painless labor. In this case the woman had been for some time an inmate of an insane asylum. Pregnancy occurs, her mental condition being good. When full term approached, a physician was called, and he found her seemingly very comfortable, seated in an arm-chair.

The woman stated she had no pain whatever, and that labor had not begun. Some spasmodic shaking of the hand at regular intervals led Dr. Gillette to suspect uterine contractions ; an examination showed a fully dilated os, and the head low down in the pelvis. The regular spasmodic shaking of the hand continued and corresponded with the uterine contractions. Forceps were used, and recovery was good.

27. *Laugier, Maurice: Annals d'Hygiène, v.*, 25, 1891, 380. Also: *La Semaine Médicale, Paris, Dec.* 10, 1890.—A woman, eight months pregnant, accompanies her child, suffering from pertussis, to the hospital. On the journey she suffers from colic, and having been constipated for five days she takes a rectal injection which causes her to feel the need of immediate defecation.

She sits on the vessel, with the right arm bent holding on to the bed for support. Child immediately expelled into the vessel with a quantity of blood-tinged liquor amnii and fecal matter. The unbroken cord was cut and tied. Child lived. Woman did not even cry out at moment of expulsion. Fifteen minutes before delivery no symptoms were present. Colic began at that time. Three years before same woman had been delivered rapidly without pain.

The writer suggests that if she had had her accident under other circumstances, if the child in falling from her had broken the navel cord and had passed into a vault below, the question whether or not there had been an intentional infanticide would have been an exceedingly difficult one to answer.

28. *Brunon: La Normandie Médicale, Rouen, Aug.* 15, 1891 ; *N. Y. Med. Journ., Sept.* 6, 1890.—Brunon recently reported to the Société

de Médecine of Rouen the case of a primipara whose labor was so nearly painless that she herself mistook it for difficult defecation and would have been delivered in the water-closet if she had not been removed from it. She only felt lumbar pains and a sense of weight in the rectum, and was not aware of the flow of liquor amnii. Brunon infers from this case that the discovery of a new-born infant in a water-closet pan does not necessarily raise the presumption of premeditated infanticide.

29. *Tarnier: Journal des Sages-Femmes, Juillet* 10, 1891; *Nashville Med. and Surg. Journ.*, 1891, *p.* 286, *No.* 8.

Case I.—A woman in Tarnier's ward had a shoulder presentation; this he corrected externally, although the membranes had ruptured some time before. A few hours afterward the cries of a child were heard, and the patient and midwife both were surprised to observe that the child was born.

Case II.—Tarnier narrates that he once delivered a woman who never stopped laughing and talking through the performance, and she declared that the uterine contractions caused her no pain.

Case III.—Another case narrated is that of a child being found between the thighs of a sleeping woman, the birth having taken place during sleep.

Case IV.—A woman, who had once experienced a precipitate labor, came to his wards, and upon retiring to the closet to defecate the child was born, the woman thinking meanwhile that a movement only of the bowels had taken place. Tarnier concludes from this and similar cases that unconscious delivery into the pan of a water-closet is possible. In these cases the cord is broken off; if there be infanticidal intent the cord is *cut.*

Case V.—Another woman, about to be delivered by Tarnier, suddenly gave birth to a child without any pain being caused, the sensation being that of something simply slipping away.

30. *Fanton*, *Archiv de Tocologie*, *No.* 2, 1890, reports twelve cases of labor in which labor occurred while the patient was in hypnotic sleep. In none of these cases were the parturients aware that labor had taken place, nor was there any complaint that pain was felt. Unless the attempt at hypnotizing was made at the very beginning of labor, before strong uterine contractions set in, in some cases it was impossible to hypnotize the women. One patient upon waking after labor said that the sensation resembled that of intoxication.

POST-MORTEM PARTURITION.

(COFFIN-BIRTH.)

THE title chosen is that used by Aveling,[1] the only author in the English language who has made anything approaching an exhaustive study of the subject. His paper, published in 1872, in the "Transactions of the Obstetrical Society of London" (Vol. XIV., p. 240), has furnished the basis for every contribution to the literature since that date, and it must be said that, except so far as the multiplication of cases, which, here as everywhere, goes hand in hand with the increase in medical writings, throws light upon it, no contribution had added anything of importance toward the elucidation of this peculiar phase of the question of pregnancy.

Post-mortem parturition acquires its medico-legal significance from the possibility of physicians and midwives, the latter particularly, being made defendants in suits for malpractice on the ground of the delivery of the child after death of the mother, and on the contention that this accident was preventable and due to lack of skill or ignorance on the part of the practitioner. The case given at length by Moritz[2] is the best illustration at command of this charge.

A midwife was called in at twelve midnight to see a woman, æt. 35, who was in labor, having been perfectly free from pain during the previous twenty-four hours. She was sitting in her husband's lap, but was put to bed and the midwife performed repeated manipulations upon her. She afterward declared that she could feel the head, but could not deliver the child. The woman died at seven A.M., still undelivered. She was buried three days later, June 23d. In consequence of the denunciation on July 5th, the midwife being accused of malpractice and death of the patient through negligence, the body was exhumed on July 28th, thirty-eight days after death.

The autopsy was made by the author of the report. The abdomen was found distended by gases of putrefaction and between the thighs lay the body of a male child, 49 cm. in length and fully matured. Its back lay uppermost with the head near the mother's knees, bent slightly forward and to the left. The feet lay near the mother's vulva. The infant was attached by a cord, 47 cm. long, to a placenta which was adherent to the uterine wall at one point only. This organ (the uterus) was completely extruded and lay between the thighs inflated to the size of a man's head by the putrefactive gases contained in it. It was inverted, of course, and with it the vagina, so that the vaginal mucous membrane lay in contact with the labia minora. The labia majora were swollen and everted. On opening the abdominal cavity, a quantity of foul-smelling gas escaped. The uterus did not lie in its usual position, but at the point corresponding to the internal os, the peritoneum was forced by the pressure of the gas toward the outer genitals and showed a slight puckered rent, through which the gas contained in the uterus could be forced into the peritoneal cavity. The womb at the same time was collapsed and could be returned to its normal situation. Decomposition was far advanced, and the examiner found it impossible to state the cause of death from the results of the post-mortem alone. He neglects to throw any light upon the outcome of the trial; in fact, he makes no mention of its having been brought into court, an omission which is unfortunately noted in all these cases.

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[1] "On Post-Mortem Parturition," etc.

[2] Vierteljahresschrift f. gericht. Med., p. 93, Bd. v., 1893 (see also Table, case No. 66, Bleisch).

Literature.—A search through works on legal medicine in French, English, German, or Italian fails to reveal a single treatise on this subject. When it receives even a passing notice, the question is dismissed without discussion (Casper-Liman, Forsyth, Ryan, Reese, Tidy, Taylor, Paris and Foublanque, Male-Smith, Puy, etc.). The cases are scattered through literature of medicine from the middle of the sixteenth century (1551) literally to the present day. The first reports were monographs in Latin (cases 1, 2, 3, etc., see table); four are taken from the *Ephemerides* (cases 7, 12, 13, and 18), and two are found in Harvey's "Anatomical Exertions" (cases 4 and 24). The collection of the older papers is the work of Aveling and is more curious than of any scientific value. The mind of the mediæval writer seemed to find it impossible to shake off the fetters of superstition and to escape the allurements of the marvellous toward a perversion of the truth. It has seemed best, since these cases number less than seventy, to tabulate them for comparative study, after the fashion of Reiman,[1] appending to his collection of 64 cases those of more recent date. His material in turn was gathered from various sources, among others from

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[1] "Ueber Geburten nach dem Tode der Mutter." Archiv für Gynäkologie, Bd. xi., Hft. 2, p. 215, 1877.

Deneux,[1] from Maizier,[2] from Meli,[3] from Toralli,[4] von Mende,[5] Casper and Aveling. Short notices of spontaneous birth after death will be found as well in Spiegelberg ("Lehrbuch der Geburtshülfe," 1878, p. 595) and Schroeder ("Lehrbuch der Geburtshülfe," 1888, p. 486).

In spite of the relatively large number of cases of post-mortem parturition and the fact that its occurrence has been recognized for three and a half centuries, it would appear that the knowledge of the subject was until recently, perhaps, by no means widely disseminated, which is due partly, no doubt, to the little notice which medical jurists have taken of it. The members of the London Obstetrical Society (1870) and of the Paris Society of Hygienists and Medical Jurists (1873) expressed, without hesitation, their doubts as to the possibility of such an event (cited by Reiman, *Archiv f. Gynäk.*, Bd. XI., p. 216, Hft. 2, 1877).

Since the appearance of the paper just quoted and that of Aveling, however, this position has been abandoned and discussion has been transferred to other points (*vide infra*). Some of the reports, abstracted in the following table, are necessarily incomplete, but we have thought it best not to omit any, in order to make the treatment of the subject as broad as possible.

In the case reported by Bleisch (No. 66) the midwife who attended the case, and who had been forbidden by the authorities to practise her vocation, was made party in a suit for malpractice. The report is shortly as follows:

> The woman died undelivered suddenly after several hours of labor in the second stage, attended by the midwife. The fact of her death and undelivered condition was verified by a physician, two hours later. Five hours afterward, the body was placed in the coffin and no signs of approaching birth were noted by several lookers-on. On the third day, when the coffin was reopened, the corpse lay in the usual position and in front of the prolapsed, extruded uterus was found the body of a child.

In this case the question was raised as to whether the prolapse of the womb was ante or post mortem, such an accident

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[1] "Mémoire sur la Cause de l'Accouchement spontané après la Mort," 1823.

[2] "De Partu post Matris Mortem Spontaneo," Berlin, 1835.

[3] "Della Proprieta Vitale dell' Utero Gravido," etc., Milan, 1822.

[4] Dissertatio Inauguralis.

[5] "Beobachtungen und Bemerkungen aus der geburtshülflichen und gericht. Med.," Bd. i., Göttingen, 1825.

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body, after Birth.	Unusual Conditions present at Birth.
1.	Rudolph Cammerarius. Silloge memorabilium med.	1551	Hanging by order of Inquisition.	Far advanced.	Four hours.	Two living children.	Birth occurred while mother's body was still swinging from gallows.	
2.	G. A. Reiss. Elysius corpus jucund. quæstion.	Unknown	Illness.	Last month.	One day.	A living child—head only born.	Not stated.	......
3.	Diomedes Cornarius Nymmanus. De vita fœtus.	Unknown	Labor; after 3 days' duration of pains.	Unknown.	Found in coffin after one month.	Unknown.	Unknown.	......
4.	Harvey. Anatomical Exertions.	1653	Unknown.	......	Found on morning after death.	Dead child between mother's thighs.	......	......
5.	Rolfinkius. Dissert. Anatom.	Unknown	Eclampsia.	......	On fifth day in coffin.	Two dead children.	......	......
6.	Bartholinus. Acta med. et philosoph. Hafn. vol. ii, obs. 35.	1673	Manipulations by three midwives during parturition.	......	Forty-eight hours.	Dead child between thighs of mother.	Body much distended (by gas?)	Birth attended by loud noise.
7.	Ressler. *Ephemerides natur. curios.* Dec. i. Ann. 3.	Unknown	Sickness.	Last month.	On third day.	One dead child (with two teeth).	Dark mottling of putrefaction.	......
8.	Ressler. Shurig, "Embryologie," p. 127.	Unknown	Eclampsia.	Beginning of labor.	On second day.	Dead child.	......	Birth occurred at washing of corpse
9.	Phillip Salmuth. Shurig, "Embryologie," p. 127.	Unknown	Unknown.	Beginning of labor.	On third day.	Dead child.	......	......
10.	Same author and reference.	Unknown	Unknown.	Beginning of labor.	"Short time."	Not stated.	......	Noise accompanied birth.
11.	*Idem*......	Unknown	Found dead.	Beginning of labor.	On third day.	Not stated.	......	......
12.	*Ephemerides*, Dec. ii, Ann ii. Shurig, *loc. cit.*	Unknown	Acute illness.	Last month.	On second day.	Dead child lying in coffin by mother's feet.	......	......
13.	Georgius Dethardingius. *Ephemer.* Ann. vii and viii.	Unknown	......	Beginning of labor.	One-half hour.	......	......	......
14.	Valerius Maximus. lib. i, Caput ultm.	......	Labor.	Beginning of labor.	"Some time" after death.	A living child.	......	Accompanied by noise.
15.	Hagendorn. Hist. med. physic., cent. iii, hist. 3.	1683	......	Labor begun.	One hour.	Living child.	......	Accompanied by noise.

16.	Johannes Matheus. Shurig. "Embry.," p. 137.	....	....	Labor begun.	One hour.	Living child.	....	**Noise.**
17.	Phillip Salmuth. Obs. med. cent. iii. Obs. i. Shurig, "Syllepsologie," p. 190.	....	Violent death.	Labor not begun.	"Short time."	Twin children dead.	....	....
18.	J. C. Menzel. *Ephem.* Memor. nat. curios. Dec. iii, ann. ii, Obs. 121.	....	Labor.	Labor begun.	Following day.	Two dead children. One found by mother's side, the other projecting through a rent in the abdominal wall caused by putrefaction and pressure of gases. Uterus ruptured.		
19.	Wolff. Observat. chirurg, Lib. i, Obs. 41.	1667	Labor.	....	Eighteen hours.	A dead child lying between thighs.	Body lay on its side in coffin.	....
20.	Bonetus. Medicin. Lentenz, p. ii, Obs. 30.	1633	Eclampsia.	Labor begun.	On third day.	Child dead, but still warm (?) attached to cord.	Placenta not freed from uterine attachment.	....
21.	Henricus Stapedius. Shurig, "Embryologie," p. 121.	....	Illness.	Not stated.	On day following.	Dead child between thighs.	....	....
22.	Schenkius. Obs. med., lib. ix. De Partu.	....	Labor.	Labor begun.	Ten hours.	Dead child.	....	Accompanied by noise.
23.	Vestingius. Obs. Anat. 7.	1630	Epilepsy (?)	....	On eighth day.	Dead child.	....	....
24.	Harvey........	....	....	....	Twelve hours.	Dead child between legs.	....	....
25.	Willugnby. "Country Midwives." Opusculum.	1650	....	Five days in labor pains.	From five to six hours.	Dead child and placenta between legs.	....	....
26.	*Gentleman's Magazine*, vol. 29, p. 390.	1759	Sudden death.	Labor begun.	Twenty-four hours.	Placenta free. Living(?) child which died.	Uterus inverted.	....
27.	Toralli. Dissert Inaugur.	1791	....	Fifth month.	Twenty-four hours.	....	Placenta free. Uterus inverted.	....
28.	Börner. *Journ. für chirurgia*, u.s.w., i, p. 519.	1793	Unknown, perhaps perforation of ulcer of stomach.	Last month.	Twelve hours.	One dead child—placenta lying in os free.	Inversion of uterus.	....

NINETEENTH CENTURY.

29.	Stark. *Archiv*	......	Only mentioned without details.					
30.	Jütterland. Schmid's Jahrbücher, 1835, Bd. ii.	....	....	Labor not begun.	On following day.	Dead child between the thighs.	....	....

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body after Birth.	Unusual Conditions present at Birth.
31.	Clarke. London Med. Repository.	1817	Sudden death.	Eighth month.	Forty-eight hours.	Dead child by mother's side.	No changes observed in corpse twenty-four hours after death. Putrefaction after thirty-five hours.	
32.	*Journ. Univer. des Sciences Méd.*, tome ii.				Twelve hours.	Dead child.		
33.	Klose. Casper's System, vol. xi, 2, 1856.	1856	Fever.		On third day.	Dead child outside vulva, attached to cord.		
34.	Hochstetter. *Zeitschrift für Staats arzneik.*, xii, 1826.				After twenty-seven hours.			Accompanied by noise.
35.	Muhrbeck, mentioned by Mende.	1844	Labor.			Dead child between mother's thighs.		
36.	Baudelocque. Denneux "Mémoires."		Labor.	Labor begun.	Five hours.			Birth sudden accompanied by noise.
37.	*Annales d'Hyg. Publiques*, 1873, ii, p. 224.		Drowning, body in water 8-10 days.		One day after being taken from water.			
38.	H. von Berne. *Med. chir. Zeit. v. Salzburg.* 1824.		Typhus.	Sixth month.	On evening before burial.	Two fœtuses.	Advanced in putrefaction.	Noise.
39.	Naumann, no reference given.	1802		Labor begun.	Thirty-six hours.	One child—placenta adherent.	Beginning putrefaction.	
40.	Wolff. *Magaz. f. Gesamm. Heilk.*, xiii, 1826.		Typhus.	Fortieth week (Xpara).	On second day.	One child between thighs.	Body putrefied. Uterus inverted.	
41.	Elias von Siebold. *Journ. für Geburtshülfe*, vol. x, 2.			End of pregnancy.	Forty hours.	One child lying with placenta between thighs.	Body putrefied.	
42.	Hoyer. Fodéré—Traité de Méd. Lég., i, ii.		Labor.		While being carried to grave.			Accompanied by noise.
43.	Bell's Weekly Messenger, 1812, Sep. 26.		Eclampsia.	Last month (primipara).	On fourth day.	One dead child.		
44.	F. J. Dillon Lanigan. *Med. Press and Circ.*, April, 1872.	1862	Labor.		On third day.			

45	Bedford, Sydney, N.S. W. Grey's Hosp. Reports, vol. x, 1864.	1864	Labor.	(VIIpara).	On seventh day	Dead male child. Head towards mother's feet.	Inversion and prolapse of uterus. It was extruded with adherent placenta.	....
46.	C H. Roach. *Med. Press and Circ.* April, 1872.	1869	Labor, after 48 hours of pains	(Primipara).	After thirty hours.	Placenta and child born together.	....	....
47.	A. C. Swayne, *Med. Press and Circ.*, April, 1872.	1872	Labor, after 24 hours.	(VIIIpara).	Child not born when laid in coffin. Found on exhuming on fourth day.	Dead child, feet toward mother's genitals. Attached to loose placenta.	Uterus prolapsed. Rent through its body.	Noise.
48.	Snow Beck. *London Obs. Trans.*	1858	Death in convulsions, after 3 days of labor.	....	Next day.	Only head born.	Body putrefied. Rent in uterus through which the child was forced.	
49.	Seibert. *Ann. d'Hyg. Pub.*, M. 39. 1879.	1873	Sickness, character unknown.	....	On third day.	One child without cord	Prolapse and inversion of uterus.	... .
50.	Official Rep. of County Physician, Skwira, Kiew, Russia.	1874	Sickness of 24 hours' duration.	....	Next day.	Examination on fourth week after death. and only skeleton of child remaining.		Body decomposed
51.	Darby. *Dublin Journ. of Med. Sci.*, 1875. ii.	1871	Typhus.	Beginning of labor (IIpara).	Seven hours.	Dead child.	....	....
52.	Casper. *Vierteljahrsschrift f. gericht. Med.*, Bd. x, Hft. 2, 1856.	1853	Death by strangulation. Murder (?)	Seventh month.	Unknown, found in medical examination.	Skeleton of child outside genitals	Body decomposed.	... .
53.	Schillinger. *Viertel. f. ger. Med.*, Bd. xi, 1. 1857.	....	Eclampsia.	....	On third day.	Dead child attached to a free placenta.	....	....
54.	Lebedew, Grodno, Russia.	1868	Burns.	(Primipara).	On third day, no signs during preparation for burial.	....	....	Accompanied by noise.
55.	Loescher, *Viertel. f. g. Med.*, xix, 1858.	1851	Labor after 24 hours.	Labor begun, waters discharged (Multipara).	Twenty-four hours.	Only head born.	....	Accompanied by noise.
56.	Frentrop. *Vier. f. ger. Med.*, xiv, 2, 1858.	....	Labor.	Labor begun, waters discharged 48 hours before death.	Twelve hours.	Child lay between mother's thighs. Placenta not expelled.	....	. ...
57.	Richter. *Viertel. f. g. M.*, xix, 1, 1861.	1861	Eclampsia.	First stage of labor.	Sixty hours.	Child and placenta found between thighs.	... .	....
58.	Richter. *Ibid.*, xix, Ht. 1, 1861.	1861	Placenta prævia, convulsions.	In labor. (Prolapse of cord and hand. VIIpara).	Fourteen hours.	Dead child between thighs.	Inversion and prolapse of uterus. Body putrefied.	....

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body, after Birth.	Unusual Conditions present at Birth.
59.	Pachur. *Med. Zeit. für Heilk.*, 1839, No. 34.	....	Sudden death.	(IIpara). Labor begun.	Twenty-six hours.	Child and placenta lying between thighs.	....	....
60.	N. Nikitin, Tomsk. *Sammlung über ger. Med.*, etc. St. Petersburg, 1875.	1871	Cholera.	Sixth month.	Four hours.	Child half expelled from vulva.	....	....
61.	Meyer. Schmid's Jahrbücher, 1855, I.	1853	Pleuro-pneumonia.	Sixth month (IIpara).	Fifty-two hours	Child free outside genitals. Placenta adherent to uterus.	Not decomposed.	....
62.	Schenk. Hufeland's *Journ. der Pract. Heilk.*, April, 1821.	1814	Phthisis.	Ninth month.	Forty-eight hours.	Child found lying between thighs.	....	....
63.	Ebel. *Journ. der Pract. Heilk.*, June, 1822.	... .	Malpractice.	From 2 to 3 weeks before end of term.	After several days at medical examination.	Child between thighs. Placenta loose, outside genitals.	Body decomposed.	No signs of birth observed 3 days after death.
64.	Klaatsch. *Zeitschrift für Staatsarzneikunde*, 1819.	1819	Poisoning by arsenic.	Seventh month, no sign of labor.	After one month at medical examination.	Child between thighs. Placenta in vaginal canal.	Inversion and prolapse of uterus. Rent in fundus.	Decomposition advanced.
65.	Ebertz. *Viertel. f. g. M.*, Bd. (N.F.) xlvii, 1887, p. 171.	....	Suspicion of poisoning.	Eighth month (primipara).	On third day. No signs on second. Med. exam. on fourth day.	Fœtus enclosed in membranes, head toward vulva. Cord twisted around neck.	Uterus prolapsed with placenta attached. Putrefaction advanced. Mass distended with gas between legs.	
66.	Bleisch. *Vier. f. ger. Med.*, 1892, Bd. iii, p. 38.	1891	Labor (attended by midwife).	Labor begun (second stage).	Autopsy on third day.	Male child between legs, attached by cord to partially free placenta. Back upward, feet to vulva.	Putrefaction advanced. Uterus prolapsed and inverted outside vulva. Labia maj. distended by gas. Uterus inflated.	
67.	Moritz. *Vier. f. ger. Med.*, 1893, Bd. v, p. 93.	1892	Labor (attended by midwife).	Labor begun.	Autopsy on 38th day. No signs of birth on 3d day.	Male matured child. Back upward. Head near mother's knees. Body attached to part by free placenta.	Uterus completely extruded, inverted and distended by gas. Rent in peritoneum. Putrefaction advanced.	
68.	Malin. *Wochens. für gesam. Heilk.*, 1834, No. 12, p. 186.	1833	Shot through heart.	Fœtal movements were noted after death.	After a short time (interval not stated).	Child born dead.	....	....

being possible during life under unskilful manipulations, *e.g.*, in the common practice of midwives of dragging on the cord to free the placenta from its attachment. A glance over the table will show how often this extrusion of the uterus from the external genitals occurred when there seems no reason to doubt that it was due to the pressure of putrefactive gases alone (cases 47, 49, 58, 64, 65, etc.). It is well to note also the fact of rents being formed in the uterine and even the abdominal walls through the same means (cases 18, 47, and 64). This might as reasonably be charged to malpractice as inversion and prolapse of the uterus. It seems probable that this accident would have been more frequently noted, if autopsies had been performed in each case. When the birth occurred before burial, the accompaniment of a noise (*Geräusch*) was not uncommon, due in all probability to the rush of gases through the vent thus offered (cases 6, 10, 14, 15, 16, 22, 34, etc.). The period of pregnancy seems to have little effect in influencing the occurrence of post-mortem delivery; it takes place with the same ease, apparently, in such a condition as prolapse of the child's hand at full term (case 58), as in the fifth month of pregnancy (case 27); in primiparæ (cases 43, 46, etc.) as in women who have borne ten children (case 40). The birth of twins was noted quite a number of times (cases 1, 5, 18, 38), a fair proportion of the number of births. Inversion of the uterus took place quite frequently without accompanying prolapse (cases 26, 27, 40); in case 47, prolapse was the only condition present; but the two were most often coincident (cases 45, 49, 58, 64, 65, 66, and 67). The interval between death and birth of the child varies between limits which compel assignment of different causes for the latter event. Dethardingius gives the shortest space of time (case 13) recorded, one half-hour, and from this, the interval lengthens into ten days (case 37). It might be said that the earlier writers are apt to report inaccuracies in such circumstances, but the number of instances are too great (cases 1, 13, 15, 16, 22, 25, 36, etc.) to permit a doubt of the possibility of birth a few hours after death. While the authors of our own century do not appear to have observed so short a lapse of time as one or two hours, Baudelocque (case 36) records a birth after five and Darby (case 51) one after seven hours, too short a period for decomposition to have proceeded so far as to generate gas enough to expel the child.

Causes Assigned for Occurrence of Post-Mortem Birth.

Three theories, according to Aveling,[1] have been advanced in explanation of the phenomenon. The first is that it is caused by the contraction of the uterine walls in *rigor mortis*. This seems hardly worth consideration, for the contractions are not sufficiently powerful to overcome the natural obstacles to the passage of the child, with the superadded narrowing and rigidity of the parturient canal from the same cause.

The second theory is that to which we have had occasion to refer repeatedly—the pressure of putrefactive gases in the abdominal cavity, acting on the point of least resistance, expelling the fœtus and pushing the uterus before it until it lies outside the genitals distended with foul-smelling gaseous products (see cases 65–67). There can be no doubt that this explanation is the true one in a majority of instances, but there still remains a class of cases which it will not cover, since the birth took place too early for decomposition to have advanced so far as to produce sufficient pressure of gas.

To cover this ground, a third cause has been proposed in the conservation of power in the uterine muscle for some time after death (two hours is the limit generally placed). The contractile irritability, preserved after death, has been noted by various writers. Fodéré[2] says that "the uterus may expel the fœtus after death, its organic action being conserved after dissolution has taken place." Baudelocque[3] found the uterus contracted after a lapse of a few hours in a woman whom he had delivered immediately after death. Arbeiter[4] found a like condition of affairs, delivery of the child having been accomplished by version and extraction three-quarters of an hour after death. During the operation, the uterus was flaccid, but it contracted later into a hard ball. Leroux[5] cites a case of the same character, and others are on record. The uterus is often said to be the last portion of the body to lose its power of contraction and the last also to undergo decomposition. (See Diagnosis of pregnancy.) It is possible then to believe that, when birth occurs within a few hours after the mother's death, the force retained in the involuntary muscle of the walls of the uterus is sufficient to complete the labor.

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[1] Trans. of Obs. Soc. of London, xiv., p. 240, 1872.

[2] "Méd. Lég.," vol. ii., p. 11.

[3] "Dict. des Sciences Méd.," xxx., p. 388.

[4] Monats. f. Geburtsh., April, 1862.

[5] "Traité des Pertes de Sang."

CAN THE FŒTUS LIVE AFTER THE DEATH OF THE MOTHER?

While we may be permitted a doubt in such a case as that of Reiss (see cases 2 and 26), in which a day passed before a living child was born, according to the author, the answer to the question must be in the affirmative when the interval is only an hour or less. In the discussion of Aveling's paper, Dr. Madge[1] stated that he had observed fœtal movements after death in several cases and wished to extract the child by Cæsarean section, but was not permitted. Brunton,[2] after a quarter of an hour, extracted a living child from the mother's corpse. Buffon and Shierig have taken living animals from the bodies of female beasts, hours after death. The writer has done the same in the case of a fox. Aveling,[3] after citing some instances of a more or less doubtful character, closes with that of the Princess Swartzenburg, sister of the Austrian ambassador at the court of Napoleon, 1810, which he describes as the most celebrated. She was burned to death late one evening in her brother's palace, and the next day a living child was taken from her body by the Cæsarean operation. If this is true (and from the position of the parties, color is certainly lent to the statement), eight or ten hours is not too long a limit to be placed upon the life of the fœtus in utero after the oxygen supply from the mother is cut off, and the cases of the older writers (cases 1, 14, 15, 16) will appear more credible.

For instances in which living children have been extracted in from fifteen to thirty-two minutes after the mother's death, see also Breslaw, *Monatsch. für Geburts.*, B. 20, s. 62; Pingler, *Monatsch. für Geburts.*, B. 34, s. 244 u. 251; Botherston, *Edinburgh Med. Jour.*, April, 1868, p. 930; Welponer, *Wiener med. Presse*, No. 1, 1879; Buckel, Trans. London Obstet. Soc., XIX., p. 179.

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[1] Trans. Obs. Soc., London, xiv., p. 240.

[2] *Ibid.*, xiii., p. 88.

[3] *Ibid.*, xiv., p. 240, 1872

SEXUAL INCAPACITY

IN ITS

MEDICO-LEGAL RELATIONS.

BY

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IMPOTENCE AND STERILITY.

PRELIMINARY OBSERVATIONS.

FROM time immemorial questions of impotence and sterility have occupied the attention of physicians and naturalists, priests and legislators.

Historical chapters in ponderous latinity may be found among old folios devoted to this subject. Even that classic master, Zacchias, from whose volumes so many medico-forensic writers have quarried, devotes several columns of his index to this subject alone.[1]

These questions, though varying according to the epoch, have taken medical and sociological importance in late years, and consequently have assumed a more scientific direction and development.

As disease leads to individual death, so does loss of genital capacity to that of the race. In its family and common relations the small number of births in France, for instance, is an economic subject that assumes alarming proportions. Even among the most prolific people in the world, those of Great Britain, it is estimated on high authority that 500,000 married women are sterile, or in other words that an average of twelve per cent of the marriages are unproductive. Statistics as to the lack of fecundity are not available in our own country, where this unhappy cause of so many empty households doubtless exists to the same extent. But as an offset to the sterile families, who would like to obey the Biblical injunction of increase and multiply, there prevail among others neo-Malthusian ideas of prevention and check and the crime of abortion, which are subjects of more alarming magnitude.

Although impotence is much more frequent among men, sterility is found in one woman out of eight, according to the statistics of Simpson and Spencer Wells, and when a marriage is sterile it is, nine times out of ten, the woman who is to blame.

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[1] "Pauli Zacchiæ quæstionum medico legalium opus absolutissimum. In tres tomos divisum." Francofurti M·DC·LXVI.

As impotence and sterility are often confounded, a correct notion of these terms is desirable. Definitions of various lexicographers, when sifted, result in attributing to *impotence* the impossibility of accomplishing the sexual act, and to *sterility* the impossibility of having children.

The difference may be explained by citing a few examples. A man, for instance, would be impotent, though not sterile, when the secretion of spermatozoids coincides with the absence of desire and the impossibility of erection, that is sometimes observed after prolonged excess or in cerebro-spinal troubles.

On the other hand, there is sterility, and not impotence where a physical obstacle to impregnation exists in a man with congenital or other defect of the penis, although all his virile faculties are intact; and the same would be true of an individual who has suffered from gonorrhœal epididymitis, notwithstanding the completeness of the venereal act; for in such cases the sperm may have lost its reproductive qualities, as it often does. Further illustration is to be found in adult castrates, in whom virile desire with turgescent penis may persist for years in spite of absolute and incurable sterility.

In women there may be impotence and not sterility, or reciprocally. The first is proved by the facts of pregnancy without intromission, as in unbroken hymen, and in the records of old trials, when suits for frigidity were so common, that women with malformations opposed to coitus have been found pregnant in spite of the husband's alleged failure of sexual power.

Though unable to conceive, it has been noticed that women are not less apt after the menopause. In fact, they are sometimes more ardent. In exceptional cases after oöphorectomy, the venereal desires and sensations are preserved. Such subjects though absolutely sterile are not impotent.

In impotence the venereal desires are present, but are wanting in *anaphrodisia* or *frigidity*, which is not so extended as impotence. All these terms apply to either sex, but some authors limit *impotence* to men and *sterility* or *agenesia* to women

QUESTIONS RELATIVE TO IMPOTENCE AND STERILITY THAT MAY BE THE OCCASION OF INQUIRY.

Impotence and sterility in either man or woman may become subjects of medico-legal inquiry in circumstances that involve questions of medical deontology; or the civil law may have occasion to call on the medical jurist in determining questions relative to adoption and contested paternity, in granting a decree of nullity of marriage, in cases of alleged adultery, and in divorce cases; while criminal law may invoke the aid of medicine in special investigations where impotence is claimed to be the result of wounds or injury, or in cases where this condition is presented as an excuse or extenuation for various overt acts, as accusations of rape or unchaste conduct, and those arising from unsound mental states.

RELEVANT ETHICAL CONDITIONS.

Several instances of a deontological nature may present themselves in which nice points arise as to doubt and conscience concerning conduct. For instance, in a case of obstinate vaginismus, or of emotional epileptiform attack, that has resisted all treatment and forms an absolute bar to the act of copulation, would a resort to sexual intercourse under the influence of a narcotic or during anæsthetic sleep be justifiable? Ether has been given in such conditions, with the consent of the two interested parties, and fecundation has resulted. In the accident known as *penis captis*, an instance of which was lately reported in a medical journal, it became necessary to chloroform a housemaid who was the cause of getting a footman in this unfortunate predicament. A similar case is reported to have occurred a few years since in Washington.

A question may also arise as to the morally binding or obligatory nature of an operative procedure to cause artificial fecundation as the last resort in certain cases of sterility. Inability to impregnate a woman may arise from other causes than that of impotence or loss of power to copulate on the part of the man. Displacements of the uterus and alteration or deformity about the neck of this organ may prevent the entry of the impregnating fluid; while a man with hypospadias has the power to copulate and ejaculate normal sperm, yet is unable to fecundate. Moreover, in the case of a man who, from loss of the penis or other material obstacle, is thereby rendered incompetent to fulfil the copulative act, the histological elements may still possess fecundating powers. In other words, both the spermatic and ovarian functions are present, but owing to original defect in the reproductive organs of one or the other sex, the generative act cannot be effectuated in common.

It is in just such cases that artificial fecundation gives paternity to the man or brings maternity to the woman, accordingly as the operation is employed to overcome impossible coitus or to introduce seminal fluid, which would otherwise be lost, into the uterine cavity, where it becomes at once profitable.

Since the physician is supposed to combat sterility by all the medical and surgical means in his power, the advocates of artificial fecundation claim it as a justifiable therapeutic measure that may be used legitimately and without compromising either professional dignity or morality. On the other hand, the operation is condemned as a social danger, chiefly on moral grounds, which seem more specious than real upon disinterested investigation. Why the manœuvres of artificial fecundation should be more repugnant or indelicate than those attending a case of confinement, the introduction of a vaginal speculum, or caring for the female genital organs after the daily manner of gynecologists, is not clearly shown. The question is purely a medical one that has lately been taken from the domain of casuistry by people of the Latin race, among whom exists a considerable literature bearing on the subject.[1] Among English-speaking people the operation has been successfully practised by John Hunter, Marion Sims, and Gaillard Thomas; and there seems to be a general agreement among medical men who have given the matter attention that when the state of the man or that of the woman is such as to render impossible the material and intimate contact of the spermatozoids and ovules, the employment of artificial fecundation is authorized upon the express solicitation and consent of the two interested parties. The operation is, however, applicable to but a small number of cases, the indications for the performance of which may be left to individual judgment and conscience; yet certain circumstances occur in which civil stipulations may raise the question of artificial fecundation. The question was favorably adjudicated by the Medico-Legal Society of Paris, at its meeting on December 10th, 1883, in regard to a judgment rendered by the tribunal of Bordeaux.[1]

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[1] See Gigon, Le Dr. P. F., "Fécondation Artificielle chez la Femme," Paris, 1871.

Among the cases in the United States Pension Office, many of which have been pushed to successful issue on less plausible testimony, is a claim for a widow's pension in which the claimant declares that at one of the battles of the late war she was a spectator, and happening to stand behind some soldiers was wounded in the abdomen by a ball that had previously wounded one of the soldiers in the testicles, from which she became pregnant and was delivered of a boy. What purports to be corroborative testimony bearing on the case, is the allegation that the boy subsequently underwent an operation for lithotomy, when a conoidal musket-ball was removed from the bladder.

Somewhat analogous to the foregoing are cases of tribadism in which an unmarried woman becomes pregnant through another woman, who from committing the simulacrum of the male act with her just after copulating with a man, brings into conjunction the histological elements.

A remaining question, connected by natural consequences to the utilitarian conception of medical ethics, is that of administering aphrodisiacs. Such substances may be prescribed by way of treatment with all the resources of therapeutics, medical or surgical, that may render possible or facilitate the exercise of the reproductive function; but the limit of duty is passed when in a special case and with a particular end in view the physician tries to provoke for a moment either a premature or an extinct function. While there is some diversity of opinion as to forcing the hand of nature by artificial fecundation, there seems to be a unanimity in condemning all efforts to provoke development of youthful instinct in a subject not yet arrived at puberty, or in the case of old age to bring back all at once the lost function, even though it might appear in the legitimate end of fulfilling conjugal duty. The general opinion is that a medical man degrades himself in prescribing what may be dangerous remedies for such a purpose; he becomes an accomplice of those devoted to criminal pleasures, and thereby puts himself in a way to merit the contempt of law and decorum.

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[1] Annales de Gynécologie, vol. xx., December, 1883.

DISPUTED SEXUAL CAPACITY AND PATERNITY.

Civil stipulations may raise the question of impotence in the case of a husband who urges his genital incapacity as a proof of adultery on the part of the wife, who became pregnant at a moment when the husband, in consequence of physical accident or moral impossibility, could not cohabit during the legal time of conception. This impossibility, physical or moral, would be one of the conditions of disavowal of paternity when a woman guilty of adultery hides the birth of the child from the husband, whose allegation of impotence in such an event would be an act that destroys the presumption of paternity. Disavowal of the child cannot, however, be based on the alleged impotence alone. Since the law recognizes that an accidental and physical cause may destroy genital power, an expert examination becomes necessary to determine the nature, the date, and the effects of this cause. Legal authorities do not specify the nature of the accident nor the causes of physical impossibility that may prevent the husband from cohabiting with his wife; but they admit the questionable legitimacy of a child born in wedlock when impossibility of intercourse or non-access[1] can be proved, or when it is in evidence that the physical accident hindering coitus has happened in the interval between the 300th day and the 180th before, and not including that of the birth of the child. According to Prussian law the impotence must be proved to have been absolute between the 310th and the 210th day before the birth. The necessity of this evidence is also established by the Italian Civil Code. This of course raises the additional question as to the normal period of utero-gestation, which, according to Blackstone, "being a matter of some uncertainty, the law is not exact as to a few days" ("Commentaries," p. 450).

The statute-books refer to the matter as "the usual course of gestation," "the course of nature," "the laws of nature," and these phrases have given rise to much discussion and opposing evidence. There is, however, a general consent among the best authorities that the average duration of pregnancy is about 280 days. This statement is based upon a careful summary of the experience of others, including Hippocrates, who agrees in the common reckoning of 280 days. The old English Code specifies 40 weeks as the limit of pregnancy; and in the celebrated divorce case of Lady Mordaunt, there appeared in her diary, against the date 27th of June, the entry "3d of April= 280 days;" and this was deemed an evidence of her guilt. In considering this subject it is well to bear in mind that the normal period of pregnancy may be shortened, or it may be protracted beyond the normal limit. It has been decided that an infant of five months is viable and may inherit; the Code Napoléon mentions 180 days; the Scotch law allows 168 days, while a court in the famous Jardine case decided against the accusation of incontinency where the child was born on the 174th day after marriage.

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[1] A husband is not a competent witness as to non-access.

From the fact that the day of insemination is not necessarily the day of impregnation, it has been pointed out repeatedly that all statements as to periods of gestation lack substantial accuracy. Owing to this variability in duration, it is, therefore, impossible to fix a definite and absolute period of utero-gestation. (See PREGNANCY, LABOR, AND THE PUERPERAL STATE, Vol. II., 263–282.)

As regards accidental impotence in contested paternity there appears to be some hesitancy among jurisconsults who have examined the subject. Some hold the word *accident* to mean an external wound or injury of palpable material nature and not an internal affection or weakness, the result of disease; while others, with more show of reason, claim that illness, either sudden and manifest or grave and long-continued, may sometimes bring about impotence as absolute and prolonged as that from surgical lesion. The Roman law admits this as a moral possibility (*Vel si ex valetudine fuit ut generare non possit*); and it would seem a conscientious decision that attributes this impossibility as much to old age and valetudinary state of the husband as to absence from home and misunderstanding.

IMPOTENCE AND BASTARDY.

In cases of bastardy interested persons (that is, the child himself, the heirs, or the mother), may contest the paternity or the maternity by alleging impotence at the moment of conception of the child. This might prove a bar to recognition and subsequent legitimacy. Objection may be made on the ground that the father at the moment of conception of the child had not yet attained the age of fecundity or that he had passed it. Legitimacy may be further contested if the child is born more than three hundred days after dissolution of marriage. It would, however, be more just before pronouncing illegitimacy to consider the cases which go to show that pregnancy may be prolonged beyond the term indicated by law. A conception may date even from the night of death. The case is recorded of a consumptive who died on the following day. But in order to establish the presumption of fecundation *in extremis* the kind of death should be taken into account, as well as the nature, character, and duration of the disease. Otherwise it would be impossible to furnish precise notions as to the legitimacy of a posthumous birth, which may or may not have occurred within competent time after termination of coverture. The heirs of the husband may contest the legitimacy by alleging the accidental impossibility of cohabitation in the last hours of life. As a rule, the paternity of a child should be established by a preponderance of evidence.

Facts other than medical, as those relating to questions of identity, may be combined in the investigation of maternity where a woman by way of disavowal urges absolute sterility as a proof. An expert examination that should determine this and the absence of all outward and positive traces of pregnancy or delivery in child-bed would be conclusive.

SEXUAL INCAPACITY AND ADOPTION.

The matter of genital incapacity also concerns the question of adoption in some countries, as in France, where it is not permitted before fifty years, if the health or bodily state renders likely the birth of a child. A similar law obtains in the German Code. The sterility must be shown before this age in order to get authority to adopt, except with special permission, when an expert examination becomes necessary. Casper reports that after a testamentary disposition, a man and wife not having the right to dispose of a capital, except at the epoch where it would be recognized that they were incapable of having heirs, he established the existence of this condition for the man and for the woman, aged seventy-three and sixty-three respectively. A law relating to adoption, and founded upon those of France and Spain, was introduced into this country by the States of Louisiana and Texas, but has since been abolished in Louisiana.

SEXUAL INCAPACITY AS IT CONCERNS THE DISSOLUTION OF A VALID MARRIAGE.

As a motive for the annulment of marriage or for divorce, impotence is of such medical and juridical importance that it is admitted as a cause by the law of most countries, and has consequently given rise to much discussion among jurisconsults and medical men.

Marriage being a *status*—a legal condition established by law—implies the ability to carry out certain conditions, the chief of these being the procreation of children. The laws of antiquity from the time of Moses show that this may fail through physical defect, as that of impotence, which easily permitted the breaking of a sterile union by divorce. Roman law had for its object the hindrance of sterile marriages; but with the advent of Christianity, and the recognition of the indissolubility of the marriage tie, as pointed out by the Evangelists Saint Matthew and Saint Mark, the laws of divorce became more and more restrictive. Yet the canon law placed impotence among the causes for dissolution of marriage, and its provisions relative to this question seem to have been subsequently adopted by the civil law.

Since questions of genital incapacity may complicate more or less the conditions that render marriage null and void, the facts that give rise to petitions for a sentence of nullity are considerable. Petitions are sometimes brought on the ground of "error in the person." Should two persons of the same sex be united to one another, rare instances of which have happened owing to a concourse of extraordinary circumstances, a union so monstrous is regarded not as marriage, but the simulacrum of marriage. Difference of sex being the essential condition of marriage, it follows that the absence of sex in one of the associates would be sufficient motive for pronouncing a decree of nullity. There are many precedents for this. A mixture of the two sexes in the same individual is also a cause of suspected civil state that may be rectified by nullity. But here it would be necessary to determine that the attributes of neither sex predominate, and that the impotence prevents either party from exercising the generative function. A further cause for nullity would be error in the sex of one of the spouses, a man mistaken for a woman or reciprocally. In such a doubtful case legal cause for the abrogation of marriage would be identity of sex, not error of the person. Such cases are only met with in so-called hermaphrodites, in whom the organic and functional vices of the procreative organs are owing simply to arrest of development. Individuals possessing this apparent sexual duplicity now come under the category of *monstrosities;* but the medical jurist cannot conform scrupulously to the classification of the teratologist, since for him there are but two genuses, the one a recognizable sex, the other indefinable and not capable of being identified. Still the coexistence in a single individual of certain of the genital organs and a blending of the anatomical peculiarities of the two sexes may render this individual incapable of acting in his or her proper relationship, and thereby be a motive for divorce. Such a case happened as early as 1654. A divorce was granted because the wife was a reported hermaphrodite.[1] For both physical and legal reasons, Chitty says in his "Medical Jurisprudence" that a charge or assertion that a party is an hermaphrodite is not actionable unless attended with actual damage. He cites the case of a dancing-master, who proceeded in an action for slander in calling him an hermaphrodite, in which it was decided that such action is not sustainable, as the words would not, in legal presumption, injure him in his profession or occupation.[2]

Medico-legal experiences in Continental Europe abound in cases where women wishing to get rid of a distasteful union bring forward the charge of impotence. This imputation, so easy to make, is acknowledged as a ground of divorce; but to be legal in English-speaking countries the impotence must be shown to have existed *before* marriage, and to be complete and incurable. The laws of some foreign countries extend the principle to impotence acquired during marriage. The Civil Code of Austria admits it as a ground for the dissolution of the relationship of marriage; while the German law, granting the same right to divorce, goes further in its liberality and extends the right to bodily infirmities that inspire disgust and repugnance or which hinder the accomplishment of conjugal duty.[1]

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[1] Ed. Med. Jour., vol. xii., p. 77.

[2] 3 Salk, 397; Starkie on Slander, 143.

Petitions for divorce have also been founded upon the extent of conjugal duty, alleging that its too frequent or too rare accomplishment altered the health, or did not accord sufficient satisfaction to lustful desire. Ancient laws as to the frequency of sexual relations establish variable limits. Viewing the difference of opinion among such wise authorities as Mahomet, who says twice a week, Zoroaster every nine days, and Solon, who says every ten days, how are we of the present generation to lay down any hard and fast rule as to this complex question?

A matrimonial offence that may serve as a point of departure in a divorce suit would be the establishment of impotence[2] in cases of contested paternity. If the pregnancy was produced at a moment when the husband in consequence of absence from his residence, or from physical accident, was in the impossibility of cohabiting with his wife, this would be proof conclusive of the adultery, and therefore a valid ground for divorce. In the United States divorce is permissible for adultery and impotence; but the laws relatively thereto have been modified by the opinions of various judges and altered by legislative acts of the several States, each of which determines for itself the causes for which divorce may be granted; so that the frequent embarrassment arising from this diversity of jurisdiction prevents any general statement of the law. In most of the States, however, divorce law appears to have been founded on the doctrines of the common law, which allowed divorce *causa impotentiæ seu frigiditatis*, and with two or three exceptions this cause is mentioned in the divorce laws of all the States.

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[1] Allgemeine Landrecht, sect. 697.

[2] A party naturally impotent cannot allege that fact for the purpose of asking divorce.

In seeking a divorce or sentence of nullity the law brooks no undue delay. In 1875, an English court dismissed the petition of a woman who had been married twenty-six years, because it was in evidence that she was an untouched virgin, and the respondent incurably impotent. A divorce on the ground of impotence was denied a husband who cohabited eight years with his wife, and delayed filing a bill until thirteen years after marriage (Peipho *v.* Peipho, 88 Illinois, 438). On the other hand, twelve years after marriage does not appear to have passed the limit in another case decided adversely to the husband, while in the remarkable divorce case of Lewis *v.* Hayward (35 L. J., P. M. and A., 105), the House of Lords held that fourteen years is not an unreasonable delay. Medical evidence showed the woman to be *virgo intacto et apto viro*, and the man apparently free from defect or malformation. In such cases the law deems insufficient the unsupported testimony of the petitioner. The person of the husband may, therefore, have to be subjected to expert examination, and in the event of his not forthcoming that of his wife, in order to determine the existence of the alleged impotence or sterility.

RELATIVE STERILITY.

Many cases, both in the lower animals and in the human species, bear out the admission that males capable of procreating in the case of one female may be sterile in the case of others. The physiology of this failure, both of production and exchange, is seemingly unexplainable. History furnishes examples of wanting sexual affinity or mental concurrence in the cases of Napoleon and Josephine, and in that of the Earl of Essex, who was sued by his countess on the ground of his impotence. Another celebrated case is cited in Hargrave's "State Trials," Vol. X., p. 24. The wife of John Bury alleged that her husband was impotent. On examination she was found to be a virgin and he to have but one testicle, the size of a small bean. The marriage was annulled. John Bury married again, and by his second wife had an issue. Dr. Ogston relates the case of two married couples without issue, who on a journey put up at the same hotel. The wives preceded the husbands to bed; but when the men retired, they respectively mistook their friend's room for their own, with the result that both women became pregnant.

In addition to the foregoing circumstances, impotence may be alleged in the suits for personal damage that are often brought against railway and other corporations. It is a matter of observation that impotence may follow profuse hemorrhage, and an old notion has prevailed since the time of Hippocrates, that bleeding from the vein behind the ear has this particular effect. An important estimate also attaches to traumatic lesions of the head and spinal cord. Concussion following blows on the head and nape of the neck have brought on impotence, and the case is related of a man in a railway accident, who escaped unhurt, but was so struck by terror that he was impotent for six months thereafter.[1] In the United States Pension Office many claims are filed for alleged impotence where there is no trace of wound or palpable lesion. A matter of fact bearing on this point is the experience of army officers, who have observed that a man of weak sexual instinct is always a poor soldier. Alleged disabilities plus the element of politics give rise to a peculiar pathology which for obvious reasons makes the medical adjudication of a claim of this kind anything but easy. In the absence of some visible, tangible, organic lesion justifying the supposition of impotence, no honest, conscientious physician could certify in such cases to the absence of virile and procreative power.

GENESIC INCAPACITY IN CRIMINAL AFFAIRS.

But in the matter of wounds or injuries there is material damage entailing a responsibility that may be taken into consideration and even become a question of fact of the highest medico-legal interest in a criminal proceeding. Legal redress may be sought in the case of impotence resulting from a wound, although the author of the act did not have that end in view. If it can be shown that impotence is the consequence of a lesion, it would increase the responsibility of its author and constitute an aggravation of the damage caused. Accidents of the kind are reported to have happened in the game of foot-ball, where loss of virility resulted from a severe kick.

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[1] Roubaud, A. F.: "Traité de l'Impuissance et de la Stérilité," t. i., p. 186.

Even a tentative at maiming with a view to cause loss of procreative power is considered an offence assimilating a crime, although the object may not have been accomplished. The offence assumes the magnitude of a crime when the maiming has for its direct motive the abolition of the generative power. Such instances of mayhem are the castrations made by the "Regulators," "White Caps," and other bands who take the law into their own hands for the purpose of avenging or righting certain real or supposed outrages. A case of the kind happened some years ago during the Ku-Klux troubles in North Carolina. The victim on being taken to a lonely wood was forced to straddle a stump to which his scrotum and testicles were nailed. A knife being then put in his hand and a cocked revolver at his head, he was ordered, under penalty of instant death, to cut himself loose, thereby causing his own involuntary castration.

THE PLEA OF IMPOTENCE IN ACCUSATIONS OF UNCHASTE CONDUCT.

In accusations of rape and other violations of sexual morality, impotence is often alleged as defense. Here the medical jurist, in addition to noting local lesions, should estimate the proper value of such circumstances as the influence of age and disease, which may cause impotence more or less complete and lasting. A man of advanced age, to whom such a sexual irregularity is imputed, may claim to be incapable of having an erection, and demand an examination of his genital organs by way of verification. Should no alteration, either congenital or acquired, be found in the organs, the presumption is in favor of sexual capacity, unless there is evident general weakness and clearly defined valetudinary state. Since doubt counts for much in criminal matters, it is well to remember that anatomical appearances, as well as age and pathological condition, may not prove conclusively the absence of procreative power, which is presumed to exist until the contrary is proved. Exaggerated development or even normal conformation of the male genital parts do not always imply great functional activity, nor do they establish the existence of genital power, the only positive demonstration of which is erection, ejaculation, and normal constitution of the sperm. All of these may exist in subjects with insufficient development of the sexual organs. In fact small size of the male parts is not sufficient ground for inferring impotence, since a very small penis may coincide with energetic passion; and well-authenticated instances are recorded in which fruitful intercourse has been accomplished by individuals with very small penis and testicles, and even with one testicle not larger than a small bean. Moreover, it is common to find a diminutive penis in persons accused of sexual outrages. Conclusion from the general state may also prove as misleading as that founded on the irregular local conformation; for men of Herculean build have often less sexual vigor than little, slim, and nervous individuals. Friederich relates (p. 251) the case of a poor, anæmic, little man, having wife and mistress, who in his second marriage was the object of a demand in separation, based upon the violence of his excesses.

Advanced age in all such questions is only an indication that may or may not be completed by other proofs, since the mere fact of age alone does not imply absence of the procreative power. While admitting age as evidence of impotence, there are numerous examples of genital activity and of fruitful marriages in very old men, facetious remarks to the contrary notwithstanding. Historical and medical authorities furnish ample evidence of fathers at eighty. Schneider relates that a young girl of twenty-six was made pregnant by a man of eighty-six years. Mende reports the same fact of a man of eighty-nine years, married and the father of nineteen children; Sir Stephen Fox married at seventy-seven years, had four children, one born to him when he was seventy-eight, twins in the following year, and a fourth child when he was eighty-one. Haller admits the possiblity of paternity to seventy years and beyond. Example is cited in Massinissa at eighty years, of Vladislaus, King of Poland, at ninety years. Dr. Gregory, of Edinburgh, says that instances are cited of the retention of sexual vigor by men of upward of a hundred years old. The uncle of Felix Plater engendered at the age of one hundred and one years, and history relates that Thomas Parr was not only censured for incontinence at one hundred and eighteen years, but was a father in his one hundred and fortieth year. The legitimacy of Lord Banbury was questioned in 1813, the principal argument against him being that the ancestor under whom he claimed was eighty years old at the date of his birth. The House of Lords, before whom the case was tried, did not sustain the objection.

The finding of spermatozoids in the seminal fluid of very old men also lends confirmation to the assertion that advanced years in men do not imply sexual unfruitfulness, much less sexual incapacity.[1]

From the foregoing facts, and the statement of Sir Samuel Romilly, that the law of England recognizes no age to which is denied the privilege of having children, it is clear that no limit can be assigned by science or fixed by law at which the power of procreation ceases.

But the real question in a criminal accusation of this class may be one of infirmity rather than of age or deformity. Vicious habits and prolonged excesses may have brought on premature exhaustion of a durable nature, which would explain the absence of the spermatozoids in the seminal fluid as well as the loss of nervous energy necessary to bring about the venereal orgasm.

It has been argued upon insufficient data that spermatozoids are not necessary for the fertility of semen. Whether so or not, we could not establish impotence from this cause, unless it were accompanied by a state of general debility or anæmia, or some chronic disease resulting in profound nutritive change. Certain diseases, however, weaken or extinguish genital power, while others increase its activity or leave it intact. Many diseases may produce anaphrodisia. The most notable from which pertinent conclusions may be drawn are those affecting the state of the blood, as scurvy, anæmia, hemorrhages, and the general dyscrasiæ; chronic disease of the bowels or kidneys, dropsy, prolonged suppuration, and fevers. On the other hand, such diseases as piles, gout, gravel, rheumatism, certain affections of the skin and bladder, pulmonary consumption, and initial lesions of the brain and spinal cord not only leave the genesic sense intact, but in many instances are accompanied by satyriasis and sexual acts of an outrageous nature. I know of a case of locomotor ataxy in a man confined to bed, who had daily connection with the attending nurse. Another case coming under my observation was that of a dime-museum freak, so weak and emaciated as to be unable to rise from a sitting posture. Yet he assured me that he copulated nightly with the buxom woman who left the room after my arrival. Several physicians know of a child that a Washington practitioner was called to see. The mother directed attention to the frequent erections of the penis and queer actions of the child. Subsequent developments showed him to be a skatophagist of the most incorrigible kind; and it was also learned that the father, who was similarly affected during childhood, still indulged in the depraved habit.

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[1] A recent case is reported of a man who contracted chancroids at the age of one hundred, and gonorrhœa at one hundred and three years. "Medical Review," May 5, 1894, pp. 355–56.

The relation of lost or weakened genital instinct to certain forms of nervous and mental disease is a question of great delicacy and difficulty. While more or less paralysis of the genito-urinary organs always follows obliteration or occlusion of the cerebral arteries, and inflammation of the brain and its meninges, yet in exceptional instances the generative function remains intact in advanced stages of nervous disease. Seminal emissions have been noticed in the last moments of hydrophobia, and in the permanent erection of cerebro-spinal meningitis, while the genital power, like a smouldering fire, often bursts out with fresh activity in some cases of locomotor ataxy, or mania, and even in dementia.

The generative function may or may not persist in individuals suffering from spinal sclerosis. It is generally absent in hemiplegia, but not always in paraplegia, unless the medullary lesion has affected the integrity of the genito-spinal centre. As a rule, genital power may be assumed to exist in sections of the spinal cord when reflex movements can be provoked; but when these motions are no longer possible, the presumption is that impotence is complete.

While the central nervous system influences the generative function both in a physiological and pathological way, on the other hand complete failure of sexual power acts upon the mental state, and may be the motive for various acts of a culpable nature. Remorse for past excesses and morbid fear may not only being on such psychic conditions as claustrophobia, panophobia, agoraphobia,[1] and the fear of a morbid impulse to

[1] See writer's article, "Agoraphobia," "Ref. Hand. of the Med. Sciences."

commit some overt act, but may actually lead to delusional melancholia, and suicide.

As a matter of common knowledge all men admit that no bodily function is more under the influence of imagination and less under the sway of the will than that of generation. This fact, therefore, seems to suggest, if it does not establish, a coincidence between sexual neurasthenia and religious melancholia, between impotence and delirium of the imagination, and may account for and extenuate some of the outrageous sexual crimes in the initiatory stage of mental disease in very old men and irresponsible persons, who though culpable may in reality be impotent. (See SEXUAL CRIMES, Vol. II., pp. 491–518.)

THE CAUSES OF STERILITY AND IMPOTENCE.

From an etiological point of view the study of genital incapacity may be limited to the general causes that concern the two individualities in their reciprocal relations, and to the more special conditions affecting each sex in a separate capacity. In the present state of biological knowledge it seems impossible to account for many of the anomalies represented by a series of well-known facts that may be cited relative to this subject. All breeders of cattle and other animals are familiar with the atavistic fact of the females "throwing back"—that is, reproducing, after impregnation by a second male, the peculiarities of some other male by whom they had previously been impregnated. This has been observed in the case of bitches of pure blood fecundated by a cur, and subsequently by one of their own breed, when the second offspring is spoiled by its resemblance to the first. The same thing has been noted in horse-breeding. A mare covered by a zebra brought forth a hybrid zebra; impregnated subsequently by an Arab horse, she foaled in succession three zebra colts like the first male. Resemblance to the donkey is present in the colts of mares who have foaled a mule and are subsequently covered by a horse; and it is further observed that the mother of a mule conceives easier by a donkey than with a horse. These and analogous facts, it is thought, explain the infecundity attending the contact of two races of very different degrees of civilization, and account for the barrenness of aboriginal women, Australian for instance, who once impregnated by a European are afterward relatively sterile with men of their own race. Doubtless this may be one of many demographic facts to explain the disappearance of the procreative faculties of certain autochthonous races who yield to the vices and diseases of races superior in civilization.

The transmission of such biological pre-existences to the children of another union is apparent in the following case. The third of six hypospadians died a few years after the birth of his three sons. His widow within eighteen months contracted a second marriage, the husband in this instance not being a hypospadian, and having no history of any such defect in his family. By this marriage he had four sons, all hypospadians. Two of these hypospadic sons begat hypospadians in their turn. But one of these sons had three boys, without any offspring, although the eldest was a hypospadian. The physiological explanation may not be forthcoming, yet abundant analogy shows the imprint of the constitution of the father in such cases to be something more than a barren ideality. A man though dead may yet exert an influence over future offspring; and paradoxical as it may seem, the assertion of one who declared sterility to be hereditary in his family is not so absurd after all from an atavistic point of view.[1]

Many facts touching the causes of sterility do not, in the present state of knowledge, admit of scientific conclusion; yet it is a physiological law that whatever enfeebles the organism enfeebles its different functions. So that union resulting from degenerated individuals, the effects of various mesological conditions, as climate, age, nutrition, and sociological influences, may react upon the reproductive faculty of both sexes. The procreative age scarcely requires comment here; but puberty should not be confounded with the age of *nubility*, since the latter is a social and political consideration rather than a hygienic question. Most physicians know of the family and social blots resulting from the ill-assorted union of physiological bankrupts. It does not appear, however, from the researches and discussions of this much-controverted subject of the marriage of near kin that consanguinity in itself has the slightest action upon fecundity. Records show that marriages of cousins are not apt to be sterile. Dr. Tidy remarks that "whereas in the average of marriages one woman in eight is barren, in those between relatives only one in ten is so." Sanson says the influence of consanguineous marriages is to raise heredity to its highest power, and according to Lacassagne, it is not, in a word, the consanguinity in itself which is healthy or morbid, but the ground upon which it is exercised.

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[1] See writer's article, "Atavism," "Reference Hand-Book of the Medical Sciences," and "Reversive Anomalies in the Study of the Neuroses," Jour. of the Am. Med. Assn. Sept. 8, 1888, also Fazio (Eugenio), "Tratato d'higiene," Napoli 2d Ed.; Bordier, A., "La Géographie Médicale," Paris, 1884, pp. 567–572, and pp. 298–303 this volume.

The influence of *hybridity* upon procreative aptitude is still a controverted question. Some anthropologists contend that crossings improve races; others that they always deteriorate. But this is an influence that seems to vary according to race and species. A mulattress has been known to have by a negro two mulatto children and eleven real negroes, and a negress to give by a mulatto nine black children and two mulattoes, while a negro has had of a white seven mulatto girls and four white boys. While the tendency in successive generations of mulattoes is to revert to the negro type, as instanced among the motley population of the West Indies,[1] it is generally admitted that mulattoes are deficient in procreative powers among themselves, and have not the same power of survival as the unmixed and more favored races.

In some cases of hybridity it is difficult to say whether the degenerative phenomena of sterility are owing to the miscegenation or to climate, as in Java, for instance, where the mongrel of Dutch and Malay gives rise to a curious mode of sterility, which manifests itself in the third generation, who are mostly girls and almost always sterile.

Meteorological influence is also a factor in causing sterility. Mamelukes in Egypt have never succeeded in creating a family with women of their own race. Non-acclimated Europeans in certain tropical countries become almost constantly barren in the second generation. This is notably so in the West Indies, where Frenchmen do not acclimate and flourish as they do for instance in Canada, under the same isotherm as Denmark; and Dr. Rochoux declares that French families not from time to time recruited, become extinguished in the third or fourth generation.[1]

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[1] See writer's "Neuroses from a Demographic Point of View," Jour. of Nervous and Mental Disease, July, 1891, also a translation of the same in Archiv. de l'Anthropologie Criminelle et des Sciences Pénales, 15 Janv., 1892, No. 37.

Extreme cold also appears to influence genesic aptitude, as noticed in the small fecundity of the hyperborean races. Two seasons spent among the Innuits enable me to verify this statement, especially among the Eskimo of Bering Strait.[2]

Many writers, admitting the influence of the seasons, assert that man, like other vertebrates, is subject to the phenomena of rut, and that conceptions, rapes, and sexual outrages are more numerous in spring. Just as this periodicity diminishes in animals under domestication, so have the social habits of civilization rendered less apparent the influences of the return of spring upon the genital sense. It has been noticed by many Eastern people that the climate of California has a tendency to arouse erotic sensibility among recent arrivals. On the other hand, a Californian tells me that he is sexually frigid until he comes East, when the opposite condition prevails. Army medical officers stationed at Fort Monroe, Va., observing the increased fecundity and the ease of the child-bearing function among recent arrivals at the post, have been so impressed with this fact as to mention it in a special report to the War Office. A diet of fish and tea is offered in explanation.

Doubtless a change from the cosmic influences of a frontier post and improved nutrition may account for the increased procreative aptitude, since so much proof shows the intimate relation existing between the functions of nutrition and generation. Gastric disturbances may often occasion anaphrodisia; notable diminution in the number of births occurs after times of famine and privation; or the procreative power may be absent in the opposite condition of exaggerated nutrition, as in the case of extreme obesity. From time immemorial the obesity of castrates has been noted, as well as the concurrence of sterility and obesity in old prostitutes. Why women of this class are so seldom impregnated is a fact difficult to explain. According to one set of statistics 100 married women give 311 births, while 100 prostitutes furnish only 60, that is to say nearly six times less. Others say that while the married woman has one child in the proportion of 18 to 100, the free prostitute has 3 to the 100, and the registered prostitute only 1 to the 100. The frequent occurrence of metritis and pelvic cellulitis, and the oft-repeated chemical destruction and other influences taken as a means to prevent impregnation, bring about a want of special excitability of the neck of the uterus, which may account for this diminished erotic sensibility and the form of sterility in question. Promiscuous intercourse is not, however, a permanent cause of sterility, since many prostitutes on marrying and stopping their trade, become pregnant under the relative repose of the organs.

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[1] See writer's "West Indies," "Ref. Hand-Book of the Medical Sciences."

[2] See writer's "First Landing on Wrangel Island with some Remarks on the Northern Inhabitants." Am. Geog. Soc., N. Y., 1883.

Several authors report examples of the absence of erotic sensibility in women who have had many children, while others report cases in which the voluptuous sensation was suddenly awakened by some obscure action of the nervous system after many years of inaction.

IMPOTENCE AND STERILITY IN WOMEN.

The part taken by woman in the function of reproduction being more complex than that of man, it results that the absence of progeny in a household is imputable to her in most cases. Sexual incapacity in woman, though not so interesting from a physiological point of view as that in man, is nevertheless a subject of greater medico-legal importance.

To notice in detail all the causes of sterility and impossibility of coitus would be to touch upon the leading topics of gynæcology. Many of the influencing conditions have already been named in discussing the circumstances in which the question may be one of medico-legal inquiry. The special causes that bear on the subject are congenital and other defects, pathological conditions, the action of drugs and poisons, and the influence of age upon the ovarian function.

It is difficult to say just at what epoch of life ovulation begins and ends, since Graafian vesicles have been found not only in the new-born but in the fœtus, and in exceptional cases the uterus and ovaries may retain their function till seventy and upward (See IDENTITY, Vol. I., p. 415). Orfila cites a case[1] in which the catamenia continued until ninety-nine. Girls have been impregnated at seven and one-half, eight, nine, ten, and eleven years, while late pregnancies have occurred at fifty-five and fifty-seven years. The Registrar-General of Scotland reports the case of a woman who gave birth to a child in her fifty-seventh year. Haller speaks of sixty-three and seventy years; White of seventy-three and seventy-seven, and in Genesis xviii. 2, we read that Sarah conceived at ninety years.

With such variable limits, the extremes of which may rather be looked upon as scientific curiosities, we are not warranted in fixing an age at which impregnation may not occur, as has been done in England; where several Vice-Chancellors have decided that fifty-three and fifty-five years exceed the child-bearing age. In an almost identical case, however, Vice-Chancellor Wickens declined to act upon the presumption that a lady of fifty-three would not have a child (Conduit *v.* Soane). The subject is one respecting which much litigation has ensued.

The menstrual state in such cases furnishes the best guide for determining the procreative aptitude, which as a rule begins with the first flow and ends with the menopause or disappearance of the menses. But as a matter of fact the fruitful period depends upon the connection between menstruation and ovulation. It is incontestable that menstruation may occur without ovulation. Although, as a rule, they occur more or less together, abundant evidence is recorded to the contrary in the cases of women who have become impregnated before the appearance of the first catamenial discharge; of others who ceased menstruating during their child-bearing life, and again of others who conceived long after the menopause.

From the study of a large number of statistical observations it appears that the first menstruations occur between nine and twenty-two years, and that the catamenia cease between forty-two and forty-eight. But the exceptions to these rules are so numerous that it seems impossible to fix an absolute age before or after which we should be justified in pronouncing an adverse opinion as to the fecundity of any woman.

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[1] "Méd. Légale," t. i., p. 25.

STERILITY FROM CONGENITAL AND OTHER DEFECTS.

Among the signs of impossible ovulation and incurable sterility, absence or rudimentary state of the ovaries is a special anatomical element which appears the most obvious; but during life these anomalies can only be suspected, not affirmed, as there is no certain sign for their detection. Some of the other physical causes traceable to the uterine appendages may escape detection during life. Removal of the ovaries leads to absolute sterility, yet in a few cases menstruation continues and the sexual appetite remains. Numerous statistics attest the fecundity of women with one ovary, who have given birth to four and five children, twins, and even triplets.

Other insurmountable obstacles in the way of vicious conformation which cause absolute sterility are occlusion of the abdominal ends of the Fallopian tubes, imperforation of the neck or of the body of the uterus, absence of the uterine cavity, and congenital atrophy or even absence of the uterus.

Though implying absence of menstruation, entire absence of the uterus does not necessarily imply absence of sexual instinct. Owing to the fact that such a defect prevents complete copulation, a marriage was set aside in the case of Drane *v.* Aveling (1 Robertson, 274). In most cases absence of the uterus is associated with absence of the vagina or some abnormity of the external genital organs. Divorces have been granted because of one or more of these causes, and the existence of such a malformation as absent vulva or vagina seems to be an absolute impediment.

As to sterility from small size of the uterine organ gynæcologists are not in accord. By some the sterility of "pubescent uterus" is considered incurable; while others admit the possibility of a cure and ultimate fecundation. In the case of robust subjects art may remedy this condition. Operative procedures may also remedy such defects as a voluminous and elongated clitoris and nymphæ as well as atresia and closure of the vagina, and thereby head off the domestic infelicity that ultimately leads to separation or divorce.

Vesico-vaginal and recto-vaginal fistulæ are additional causes of genital incapacity in women. The three orifices of the vagina, rectum, and urethra forming a common opening has been observed in a non-viable individual. Impregnation has, however, been observed in one case of vagino-urethral deviation.

The foregoing defects are barriers to marriage, yet the question of advisability of marriage, which a physician may be called on to decide, should not be hastily discouraged or forbidden, since each case may have merits of its own. The real issue in cases of congenital defect is not so much a question of copulation or impregnation, but rather the possibility of remedying the defect by operation. A court has held that the husband was entitled to a decree in a case where the woman might probably be cured if she submitted to an operation involving no great risk of life, which operation she refused to undergo. From a legal point of view such a condition is deemed equivalent to a permanent and immovable malformation that would hold valid in the matter of divorce.

PATHOLOGICAL CONDITIONS OF STERILITY.

Deformity of the pelvis from rickets, causing narrowness that prevents entrance of the penis, is a cause that has been judicially admitted. Sexual relations may also meet with hindrance in vaginal stenosis resulting from disease or injury; from an imperforate hymen; from tumors of the labia majora; and from elephantiasis of the external genitals. Uterine diseases and displacements, though ordinary causes of sterility, are not always absolute obstacles, since many of them are curable, and impregnation has been known to take place in a case of procidentia observed by Chopart. Catarrh of the uterus, affections of the uterine appendages, and general constitutional affections, as syphilis, tubercle, scrofula, heart disease, obesity, and functional nervous diseases of obscure nature, are also considered as causes of sterility.

The action of drugs and certain toxic substances are thought to be causative factors. It is quite possible to bring about a general neurasthenic condition with wasting of the ovaries by iodine and the iodides; and the absorption of certain substances, as the sulphide of carbon, may also diminish the genesic faculty, while the gonorrhœal virus may bring about the same condition; the action of many other so-called anaphrodisiacs is problematical in the extreme. Notwithstanding the great learning and research brought to bear on the subject, it is impossible in some cases to find any pathological conditions to account for the sterility.

IMPOTENCE IN MAN.

Frequent causes of impotence, as extremes of age and other defects, being already mentioned, in discussing the circumstances in which sexual incapacity may become the subject-matter of inquiry for the medical jurist, it is not necessary to recapitulate to any great extent.

Natural absence of the penis or of the testicles is an obvious physical condition that would seem to preclude regular and natural copulation. Yet the absence or malformation does not necessarily imply impotence, since the conditions sufficient for impregnation exist in some such cases, and the possibility of causing fecundation without coitus should be kept in mind. Nor do the opposite conditions of enormous size, bifurcation, or double penis justify a charge of impotence, although they might of sterility. Many Eastern medical students of twenty years ago may recall the Portuguese with three legs and double penis, both of which he asserted became erect during copulation.[1] I have lately examined and had photographed a singular case of duopagus penis in the person of a German, a former cavalryman of the United States army. The two organs were soldered together as one sometimes sees in fingers or toes, and the end of the glans was divided by a slit-like opening with labia and other characteristics of the female external genitals. This man also assured me of his sexual capacity, which had not been exercised in late years, owing to the pain attending the act.

Irregular erection from shortness of the frenum may also prove an obstacle to impregnation by diverting the ejaculation in a manner to prevent fecundation. Absence of the urethra or imperforate penis would, however, be more positive obstacles.

The question involved in all such cases is one of degree; for minor degrees of hypospadias and epispadias are consistent with paternity, the incontestability of which is attested by heredity and atavistic facts that have been noted by different authors since the time of Zacchias. Moreover, gonorrhœa has been observed in a patient with epispadias; and in the case of a hypospadic boy of seventeen summoned on a charge of affiliation the paternity was affirmed, notwithstanding the plea of the defence that it was impossible for him to be the father because of this infirmity.[1]

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[1] Annals of Gynecology, Nov., 1888, p. 100.

While the absence of genital power from extreme degrees of the foregoing malformations does not admit of much discussion, there are, however, cases in which it would be impossible to say positively whether impotence or even sterility exists.

Congenital absence of the testicles in the imperfect state of non-descent, where these glands retain their abdominal or lumbar position, presupposes the establishment of impotence; but many substantive facts testify to the contrary. Not only have spermatozoids been found in cryptorchids, but paternity in several instances has been imputed to them, as well as accusations of rape and sexual immoralities.[2] It therefore seems that retained testicle is not in itself an absolute bar to marriage, an infallible evidence of non-paternity, nor a proper ground for divorce, notwithstanding the rule that cryptorchids as a class are non-prolific.

No exception can be taken in the case of a subject with but one testicle. A case is cited of a monorchid condemned and executed for rape following murder. A man in Washington with the same defect—if it can be so-called—has a family of ten children.

INFLUENCING CONDITIONS ARISING FROM ACCIDENT AND DISEASE.

The genital gland being the only trustworthy characteristic of sex, there is consequently no sign that attests the absolute extinction of the procreative function so well as extirpation of the testicles. Nevertheless, in castrates the power to copulate in a small degree sometimes persists, and there is even a possibility of fruitful intercourse taking place. A case is recorded of the many sexual misdemeanors of four castrated soprano singers who were banished from a small Italian town. The possibility of fecundation rests upon the fact of recent castration after puberty; the discovery of semen in the vesiculæ seminales; upon the analogies in animals, and upon instances in man. Sedillot cites a case in which a man became a father after the removal of both testicles[1]; and in Henke's *Zeitschrift*,[2] a husband is reported to have impregnated his wife after losing both testicles from a gunshot wound. There seems, however, to be some doubt as to the correctness of the observations on this subject; and the evidence is further complicated by the possibility of only a small piece of the healthy gland remaining intact, which it is clear would not warrant the assumption of sterility.

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[1] Med. Times, Sept. 21st, 1850, p. 321.

[2] Quatrefages, Thèse de Strasbourg, 1852.

Traumatic lesions may also arrest the functions of the testicle. Violent contusions have been known to bring on rapidly this condition.

An accident or an operation causing entire absence of any intromittent organ would in all probability result in impotence, but such a person, though rendered incompetent to copulate, may be able to impregnate, for reasons already assigned in dealing with artificial fecundation.

A scrotal hernia may be the manifest cause of incurable impotence, especially where it is of long standing, irreducible, and so large as to surround the penis. Elephantiasis may similarly affect. Hydrocele, phimosis, and paraphimosis, being only temporary obstacles, are not admissible causes. But it is possible that surgical operations for the relief of these conditions may lead to impotence and sterility, as in the case of lithotomy.

Pathological atrophy of the testicles following measles and mumps is said to bring about a condition analogous to the arrest of genital development known as *infantilism*. Cases of orchitis or epididymitis followed by atrophy appear to be more common among the Latin races. In 452 cases of parotiditis among soldiers, Laveran has observed 156 of orchitis, 75 of which were followed by testicular atrophy. Prolonged statistical search as to the atrophy of these organs in such cases fails to show that impotence is common from this cause either in England or the United States.[3]

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[1] Manual, p. 17.

[2] 1842, vol. i., p. 348.

[3] In a late epidemic among Indian troops a medical officer of the U. S. Army has observed thirty per cent of epididymitis.

If it can be established that cancer or sarcocele has completely destroyed the two glands, impotence may be assumed to exist. Other diseases of the testicle, as abscess, tubercle, and double epididymitis from gonorrhœa affect more or less its structure and prevent spermatogenesis. Many other causes hidden to the observer, such as closure of the ejaculatory canals, hardening of the veru montanum, and engorgement of the prostate escape examination, and for that reason have no definite place in legal medicine.

Among the more frequent cases of impotence and sterility that come under observation, especially that of the neurologist, are those in which the organs are intact. They usually result from early and prolonged excesses, either of a natural or unnatural character, and are practically incurable. Signs of decrepitude and loss of bodily power from general disease may sometimes come within the category of *doubtful* cases of sterility. Many physicians know that syphilis may induce sterility without appreciable lesion of the genital organs, yet the fruitfulness of many syphilitics is unhappily a notorious fact. A just medico-legal estimate of the foregoing remarks is summed up in the case of a noble Roman who thus exposed his scruples to Zacchias, when pressed to marry in order to perpetuate his race: "*Brevitas penis, ætas, quædam ignavia aut segnities, quondam morbus gallicus.*" On discussing these motives the doubts were dissipated by the physician, and a marriage was brought about which was fruitful.

A paralytic old man of eighty-four years is cited by Taylor as a case of disavowal of paternity which was admitted.

Many other pathological causes of impotence and sterility come within the domain of the later researches in psychiatry and neurology. But the law, following in the wake of medicine, may not recognize them at the present juncture, and a court may be slow or even refuse to make a decree in cases where such questions are involved.

EXPERT CONCLUSIONS.

Certain signs furnished by necropsy may remove doubts and enable the investigator to form correct conclusions. But the advance of science renders it possible to establish the absence of genital power in the living with a reasonable amount of certainty. The medical jurist has nothing to do with proving its reality, as this power is assumed to exist until the contrary is proved. In conducting an examination for this purpose there should always be a witness present, and if the conjoints are to be examined it is best that the same man should not examine husband and wife. The local examination should not be made without the consent of the person, and in case of refusal the consequences are purely legal. All gross or indecent manipulations of the genital organs are to be avoided, for the reason that they are unnecessary. Although conducted with system and scientific decorum, the examination may lead to a most guarded opinion; but in most cases medical knowledge, good sense, and conscience may enable the medical jurist to form a just conclusion.

MEDICO-LEGAL CONSIDERATION

OF

RAPE.

BY

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RAPE.

RAPE, derived from *raptus mulierum*, signifies carnal knowledge of a female by a man forcibly and unlawfully against her will. More accurately, the words,[1] "where she does not consent" should be used instead of "against her will," following the diction of the statute of Westminster 2, defining the offence, since the crime may be committed where no will at all is exhibited, as where the woman is under the influence of drugs or *non compos mentis*. It may, moreover, be committed when the act is not strictly against her will, but is effected without a conscious and proper consent, as by fraud or intimidation.

LAW OF RAPE.

Female chastity, justly recognized as the foundation for the superstructure of family and state, has been hedged about by civilized nations, ancient and modern, with but few notable exceptions, by all the safeguards within the power of jurists to devise, and from the earliest times the heaviest penalties have been placed upon its forcible violation. With the Jews, it was punished by death, in case the woman was betrothed; by a fine of fifty shekels paid to the father and marriage without the possibility of divorce for any cause, if she was not. The Roman law which was even more severe, visiting the offender with death and confiscation of goods and, taking the chivalric view that the man is always the responsible party, made the penalty the same whether consent was given or not. It even failed to distinguish between rape and debauchery. The Saxons held chastity in the like esteem and punished rape with death. Beck[2] has collected some very interesting and curious data relating to these laws among both ancient and modern nations.

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[1] "Against her will" equivalent to "without her consent;" authorities, Com. *v.* Burke, 105 Mass., 376; Reg. *v.* Fletcher, 8 Cox C. C., 131; Reg. *v.* Camplin, 1 Cox C. C., 220; Reg. *v.* Ryan, 2 M. C. C., 15.

[2] "Elements of Medical Jurisprudence," 11th ed., Philadelphia, 1860, i., 212–224.

With the advent of William the Conqueror, the penalty imposed by the Saxons was changed to castration and loss of eyes.[1] In the 3d Edward I. this was judged too severe; rape became a trespass only, punishable by two years' imprisonment, but the prevalence of the offence made such rapid strides that in the 13th Edward I. it was again made a felony and has so continued in that country and this. During the present reign, by the 4th and 5th Vict., c. 56, sec. 3, imprisonment or penal servitude for a term of years has been substituted for the prevailing death penalty, with a resultant increase in the crime from fifty to ninety per cent over statistics for preceding years in four years. In this country, a majority of the States agree with the English statute, although the Southern section almost unanimously reverts to the older punishment.

By the common law of England, emission must occur. This provision furnished too large a loophole of escape for malefactors, and under George IV. was so altered that carnal knowledge came to mean the *slightest penetration.* Ohio furnishes the only exception (State *v.* Blackburn, 22 Ohio St., 120) to prove the rule in the United States.

Consent.—The female is incapable, by common law, of giving consent, if under thirteen years of age (43d and 44th Vict., c. 45, sec. 3); between thirteen and sixteen years, carnal knowledge is only a misdemeanor; if over sixteen years, and consent is given, it is no longer a crime. The offence is not mitigated by proof of yielding to fraud or by any subsequent acquiescence, it matters not how soon that follows. The woman may consent during the act, but the moment the male organ is withdrawn, all power on her part to mitigate the offence is gone. Further, it is not a defence if she was forced, after repeated acts of sexual intercourse with full assent and coöperation.

The law on rape by fraud is not so clear (see rape during sleep). In general, rape accomplished by deception remains the same. But in an English case (Russ. & Ry. C. C., 489) a majority of judges held a man who succeeded in obtaining a woman's favors under the supposition that he was her husband, not guilty of the crime. At the same time, the judges intimated that, in another case, they should direct the jury to bring in a different verdict. The common law does not permit forcing of a prostitute and gives her power to withhold consent, taking the view that her person is not public property, so long as she does not interfere with the rights of others and that she may be on the point of a reformation. Rape cannot be committed on a wife, since she gives herself to her husband by the contract of marriage, but may be committed on a mistress. All parties aiding and abetting are principals in the second degree. Thus, a woman, a boy under the age of puberty, or a husband, in the case of his wife (the instances of this with the object of procuring divorce are not uncommon in law reports) may lend aid to the accomplishment of the act.

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[1] Miller: "The Law of Rape," Bulletin New York Medico-Legal Society, vol. i., p. 109-113 (1878-79).

Testimony.—For apparent reasons, an attempt at violation is usually committed when the woman and the would-be ravisher are alone. This being the case, the law considers the testimony of a single witness, the prosecutrix, as competent. Her complaint should be made at the earliest possible opportunity, but delay will not prejudice her case if she were still under control of the accused or held in fear by him. That the complaint was made shortly after the crime may be proved, but not its particulars. Since her testimony alone will establish the charge, evidence in rebuttal may be introduced and the complainant's character impeached. Moreover, she is not privileged from answering any questions put to her. Her previous character for chastity and the circumstances of the assault, whether she offered resistance or not, whether the assault took place in a lonely spot, whether she cried out, whether she could have been heard by persons in the neighborhood, etc., are all important as bearing on the question of consent.

Corroborative Testimony.—False accusations of rape are exceedingly common (the proportion being twelve false to one true, according to Professor Amos),[1] and medical evidence is usually demanded as corroborating proof. The examination should be made as soon as possible, for the signs of an attempt often disappear with remarkable celerity, sometimes in three or four days. Nevertheless, a much longer time may often elapse before the medical inquiry is instituted, and consequent errors may and often do creep in. In our synopsis of 200 cases occurring in children, the average interval was something more than nine days, while in individual cases it lengthened out to weeks or months, in one or two instances a year or more.

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[1] Although we cannot, from our cases, approach in any way an exact proportion, still, in view of the fact that certificates of complete penetration were given in 108 of 176 cases, and 44 convictions were secured, it would appear that Amos' law does not always hold good.

The physician, on being summoned, should be scrupulously careful to note the exact time of his examination. This may appear, at first sight, of little moment and outside the medical witness's province, but it will be easily shown to be of the greatest importance. It will afford the defence opportunity to discover if the plaintiff made her accusation as early as possible, and may prevent the escape of the accused on an *alibi* falsely set up. The time of the alleged assault should be noted as well, since it may enable an innocent man to prove that he could not have been upon the spot. The examination, while it should be made at once without permitting the female time for preparation, cannot be made without her consent. In case she should refuse, however, the refusal would tend largely to invalidate the truth of her charge.

There are four points to be noted in the evidence of the physician: (1) Marks of violence about the woman's genitals. (2) Marks of violence on her person or on that of the accused. (3) Stains of blood or semen on the person of either or both. (4) The presence of venereal disease, gonorrhœa, syphilis, or chancroid, in one or both. These subjects will be considered more in detail under the various sub-headings of the chapter.

The form shown on p. 419 is offered as a convenient history blank for recording and preserving data of examinations for evidences of rape, and is a copy of the one used in preserving the histories of the cases referred to in this article. The records of these 176 cases analyzed have never before been published.

Medical testimony is equally as important in an attempt as in rape itself, if it is not the most weighty part of the case, and should be given with the greatest circumspection. The crime is a misdemeanor punishable with imprisonment or fine. The man who attempts to know carnally a female under the age of sixteen, even though he does so at her solicitation, is held guilty of a misdemeanor.

Assault.—The law regards a handling, a touch, or an attempt to touch, by a male, any part of the sexual organs of a

CASE........ **DIAGNOSIS**........

RECORD OF EXAMINING PHYSICIAN.

(*Date*)........................*18*....

Name...

Residence...

Age......*yrs*......*mos.* *Birthplace*.....................................

Time in this country...

Color and Race.................... *Occupation*......................

Brought to office by...

Injury said to have occurred........ .. ..*18*.....

Case...

EXAMINATION: (*Date*)............... ..*18*......*Place*................

Interval between injury and examination...............................

General condition...

Marks of struggle or violence.................. ....

Ostium vaginæ admits........*fingers.*

(Labia; anus; vulval canal; fourchette; vulvo-vaginal glands: hymen: carunculæ myrtiformes; clitoris; urethral meatus; discharge, urethral and vaginal; vagina; cervix; uterus; stains; skin; breasts.)

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....

Presence of venereal disease.................

....

....

Examination of discharge and stains.........

....

....

....

Diagnosis..... ....

....

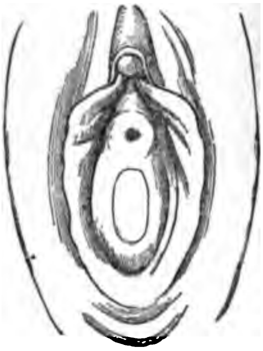
Certificate submitted (*copy of*)..............

....

....

Remarks and subsequent history..............

(*Charge. Plea. Verdict.*)



Diagrammatic Outline of the Vulva of a Child. Hymen is left blank. Shape of hymen, situation and extent of lacerations, abrasions, etc., are to be indicated on the figure with ink for future reference.

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female, genitals or breasts (or even feeling her lower extremities in some States) without her consent, as a criminal or indecent assault. It applies as well whether they are covered by clothing or not. Physicians are not likely to be called as witnesses in these cases, except in the event of the communication of disease, syphilis particularly. Here, as for rape, the age of consent is sixteen years. We append a table showing the nature of the crime, the age of consent, and the penalty, in twenty of the States of the Union, which is interesting in more than one particular.

TABLE SHOWING AGE OF CONSENT, PENALTY FOR ASSAULT, AND NATURE OF OFFENCE IN TWENTY STATES.[1]

STATE.	AGE.	PENALTY.	MISDEMEANOR OR FELONY.
1. Illinois........	14	Penitentiary, 1-14 years.	Felony.
2. Louisiana......	12	No such offence, *eo nomine.* Penalty same as for rape.	Felony.
3. California.....	14	Penitentiary, 2½ years.	Felony.
4. Wyoming	18	For rape, 1 year-life. For assault, not more than 14 years.	Felony.
5. Nebraska..	15	Rape, 3-20 years in Penitentiary. Assault, 2-15 years in Penitentiary.	Felonies.
6. Ohio...........	14	Rape, under age of 12, life imprisonment. Over 12 and under 14, 3-20 years. Assault, 1-15 years in Penitentiary.	Felonies.
7. Missouri.......	14	Penitentiary, 2-5 years, or fine or imprisonment in County Jail.	Felony.
8. Michigan..	14	State Prison, not more than 10 years, or fine not exceeding $1,000, or both.	Felony.
9. Pennsylvania..	16	Imprisonment, not more than 5 years, or fine not exceeding $1,000, or both.	Misdemeanor.
10. Connecticut....	16	Rape, not less than 3 years. Assault, not more than 10 years.	No distinction.
11. Vermont.......	14	State Prison, 10 years, or $1,000 fine, or both.	Felony.
12. Iowa...........	13	Imprisonment for not more than 20 years.	Felony.
13. Georgia........	14	Rape, death. Assault, 1-20 years.	Felony.
14. Maryland......	14	Rape, death or imprisonment for life. Assault, 18 months-21 years.	Felony.
15. Kansas	18	Hard labor, 5-20 years.	Felony.
16. Mississippi	10	Penitentiary, 10 years.	Felony.
17. Texas..........	12	Rape, death or imprisonment.	Felony.
18. Idaho..........	14	Imprisonment, 5 years-life.	Felony.
19. Oregon	14	Rape, 3-20 years.	Felony.
20. Alabama	10	Death or imprisonment for life.	Not stated.

[1] The data for the above table were kindly secured for us by Dr. W. Travis Gibb, examining physician to the Society for the Prevention of Cruelty to Children. We also owe our thanks to George C. Morrison, Esq., of Baltimore, for aid in the preparation of the legal matter.

The age of consent in the States and Territories not found in the preceding table is as follows: Maine, 14 years; New Hampshire, 13; Massachusetts, 14; Rhode Island, 14; New York, 16; New Jersey, 16; Kentucky, 12; Indiana, 12; Wisconsin, 12; Montana, 15; New Mexico, 14; Washington, 14; Arizona, 14; South Dakota, 10; North Dakota, 14; Virginia, 12; West Virginia, 12; North Carolina, 10; South Carolina, 10; Florida, 17; Tennessee, 13; Minnesota, 10; Nevada, 14; Arkansas, 14; Colorado, 10; District of Columbia, 16; Utah, 13. In Delaware, unless recently repealed, the statute still stands in rape cases at the astounding age of 7; a late act, pertaining to seduction, fixes the age at 16.

The age of consent varies widely in different quarters and from the age in common law. In the South, where puberty is reached early, the difference may be eight years from the time appointed in more northern commonwealths. In the Middle States, we strike the golden mean, fourteen years. In Pennsylvania alone the crime is a misdemeanor; elsewhere, it is a felony. In the Southern States, again, the penalty is most rigorous, being commonly death, a necessary provision considering the low age of consent and the prevalence of the crime among the negro race, which in several commonwealths equals the white population in number, and in Mississippi and Alabama outstrips it. Wyoming, placing the age at eighteen, enforces also the lightest penalty for rape. The table was compiled from answers furnished by the Attorneys-General (or some other State officer, as in the case of Vermont, which has no Attorney-General) to the following questions: (1) "What is the age of consent in your State?" (2) "What is the penalty for indecent assault?" (3) "Is the offence a felony or a misdemeanor?"[1]

DIVISION OF THE SUBJECT.

For the sake of convenience and clearness in consideration of the complex subject-matter, the chapter will be divided into four parts: (*A*) Rape on Females after Puberty; (*B*) Rape on Children and Infants; (*C*) Rape by Boys and Women; (*D*) Rape on the Dead (Necrophilia). False accusations will be considered as they occur in each subdivision.

A.—RAPE ON FEMALES AFTER PUBERTY.

Wide differences naturally exist in the violation of virgins and of married and adult women habituated to sexual intercourse, but these differences are hardly great enough to warrant the separate place for each, commonly accorded in works on medical jurisprudence. We shall begin with a description of the signs of virginity in girls and young adults.

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[1] It should be noted that in answering the question as to the penalty for indecent assault, some doubt seemed to exist in the minds of several of the attorneys-general as to the exact meaning of the term. In six cases, the punishment for both rape and assault with intent to know carnally are given under the appropriate head; where no such heading occurs, only one answer was returned; when the penalty for rape alone is given, it appears under that head. In Louisiana, the law recognizes no such offence.

THE SIGNS OF VIRGINITY.

Genitals.—The *labia majora* are firm, plump, and lie in close apposition with each other, perhaps slightly parted toward the posterior commissure, but covering the urinary meatus. Separation at this point has been considered an evidence of habitual manipulation of the organs, but it may occur as the result of slight atrophy from perfectly natural causes. The median line showing their juncture is situated below and behind so as to be completely obscured in the erect position. The whole vulval canal is comparatively short, much more so than is found in young children. (See accompanying colored plate.)

The *labia minora* or nymphæ are rose-tinted, completely covered by the greater folds. It is claimed that they are elongated by the practice of onanism, producing in them the same changes occasioned by repeated sexual indulgences. This practice does undoubtedly bring about changes in the *clitoris*. It increases in size and becomes more facile of erection. Brouardel,[1] however, cites the case of three sisters with whom the enlargement of the clitoris was congenital (*vide infra*).

The *fourchette* and *posterior commissure* are rarely destroyed by sexual intercourse, although they are commonly ruptured at the first delivery. This fact is of considerable importance, diagnostically, but it will be shown that the accident is not so infrequent in attempts on children.

The *hymen* is the sign of virginity, *par excellence*. Numerous authors have been at great pains to prove that its existence is by no means invariable (the older writers on the subject are particularly prone to take this view), but it is safe to assume that in one form or another its presence is so constant as to make the few exceptions of little importance. Orfila in 200 observations, Tardieu in 500, Devilliers in 150, Fredet[2] in 50, and we in 176, never failed to find the hymen or the remnants of it. Where a writer claims its non-existence in eight cases out of twenty-four, it is pretty clear, in face of these 1,076 examinations, that his methods were at fault.

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[1] Annales d'Hyg., vol. x., pp. 60, 148.

[2] "Viol et Attentats à la Pudeur," Annales d'Hyg., 1880, pp. 248–251.

EXPLANATION OF PLATE V.

FIG. I.—External Genitals of a Virgin in their Natural State.

FIG. II.—The same with Separation of the Labia Majora, showing the Labia Minora, Meatus Urinarius, and Crescentic Hymen.

FIG. III.—The External Genitals after Intercourse, showing Rupture of Hymen to Base of Attachment.

FIG. IV.—Genitals of a Woman who has Borne Children and is Again Pregnant. The greater lips are sunken and have lost their plumpness; the lesser are hypertrophied and project beyond them. The mucous membrane of the vaginal entrance shows the characteristic purplish wine-color of pregnancy.

MEDICAL JURISPRUDENCE—PLATE V.

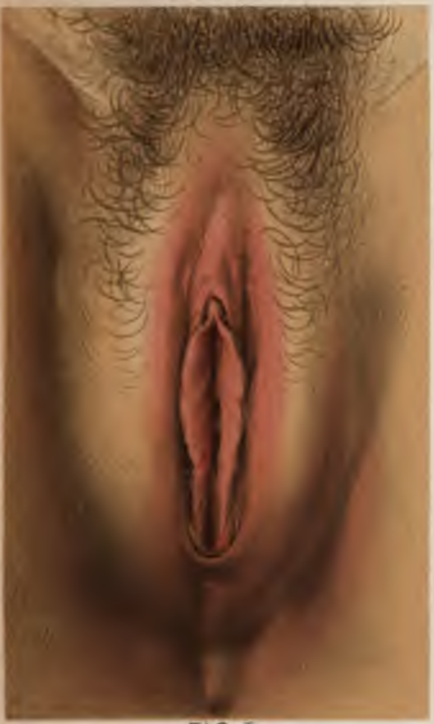
FIG. I

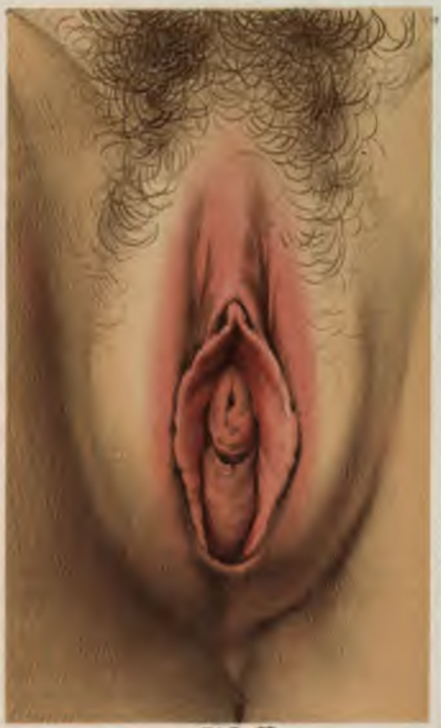
FIG. II

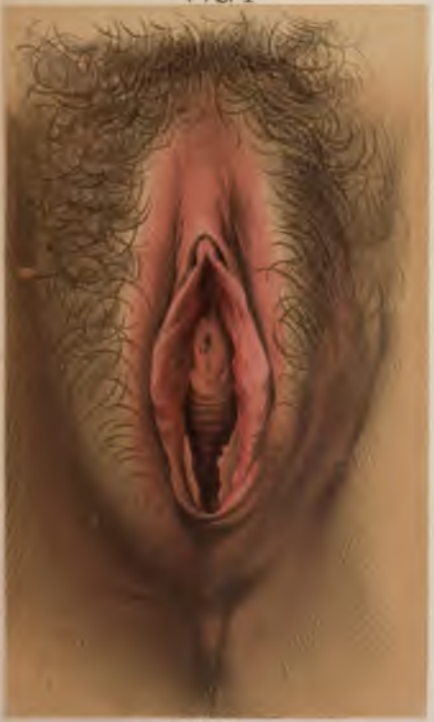
FIG. III

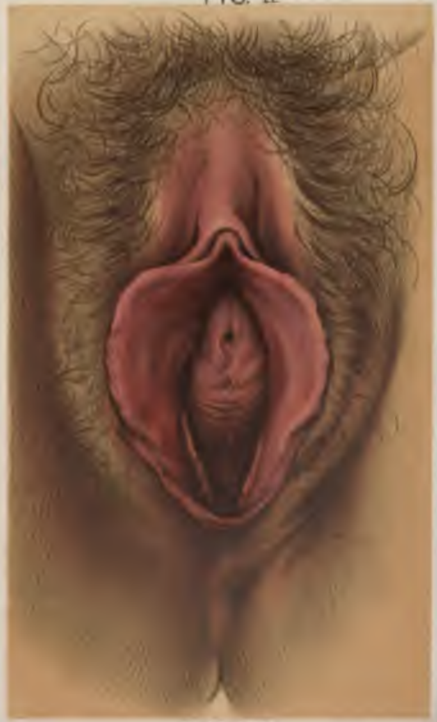
FIG. IV

The hymen[1] is a thin membrane stretched out over the entrance to the vagina and separating it from the external genitals. It has the same structure as the vaginal walls. It is, in fact, but a reduplication from them, formed of the same fibrous and elastic tissue with the vessels and nerves and covered by the same epithelium. Its situation is rather superficial in young women, much more so than in children. Its thickness varies from one to three millimetres (Tourdes[2]) and its consistence may be of any character from firm and almost tendinous to soft and elastic. Its orifice is not usually situated in the centre but nearer to the meatus (shown in accompanying colored plate), and in its normal condition will usually permit the passage of a finger into the vagina without rupture of the borders of the membrane.[3]

It is due possibly to the numerous forms of arrested development, of vices of conformation which it presents, that its absence is so often stated.

There are four principal forms with numberless variations in each: the form of hymen with a central, antero-posterior slit, the semilunar, annular, and diaphragmatic. Of these, the first and third are more common.

The first variety consists of two folds, placed on either side of the opening with a central slit between them, running antero-posteriorly, like a buttonhole (Fig. 62). It is the usual shape in children. The semilunar fold is situated with its thickest portion at the posterior commissure and the horns running up the sides of the os vaginæ

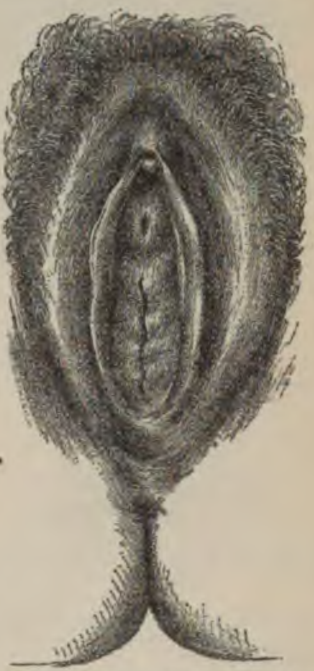

FIG. 62.—Hymen with Central, Antero-Posterior Slit.

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[1] Edin. Med. Journ., vol. xxiii., p. 906.

[2] "Viol et Attentats aux Mœurs," vol. iii., series 5, pp. 658–699, "Nouveau Dict. de Médecine et Chir. Prat."

[3] Lutaud: "Etude Méd. Lég. sur l'Hymen," Rev. de Méd. Lég., vol. i., 1–6.

and tapering off toward the meatus. It is, as a rule, very regular and becomes accentuated with the progress of age (Fig. 63). The annular form is almost infinite in its variations, but its usual shape is a circular band with a large central opening (Fig. 64). It may be shrunken to a mere strip and is then little likely to be ruptured by coitus, or it may close up, leaving only a pin-head opening. This forms the fourth variety, the diaphragmatic (Fig. 65). (These appearances are shown in accompanying cuts.) Here, there may be two small apertures on either side of the median line or the membrane may have the appearance of a sieve (cribriform). The edge of the circular membrane may be split by a number of little clefts (fimbriated), which should not be mistaken for the slight tears produced by intercourse (Fig. 66). When the clefts become accentuated, as happens in rare cases (Tollberg), until they reach the wall, the hymen is said to consist of multiple

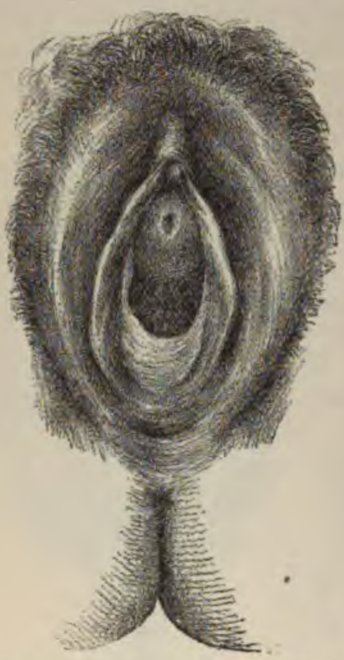

FIG. 63.—Semilunar or Crescentic Hymen.

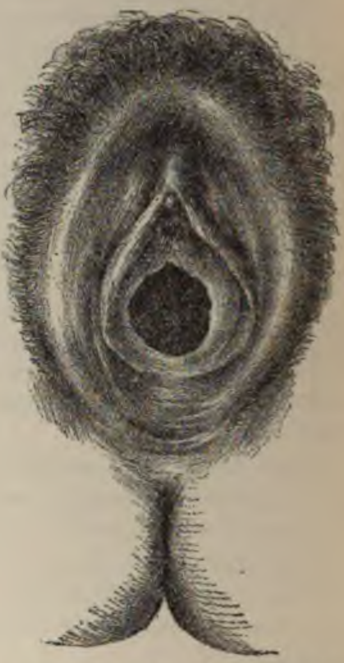

FIG. 64.—Annular or Circular Hymen.

folds. One more form is described (Tourdes), in which a central band divides the orifice, antero-posteriorly. This is only of importance in so far as the band may be incomplete and give the impression of having been ruptured. After puberty, it frequently happens that the orifice does not appear clearly defined but lies in folds,[1] so that the form changes with traction and the whole surface can be seen only by passing the finger behind the opening and pulling it forward.

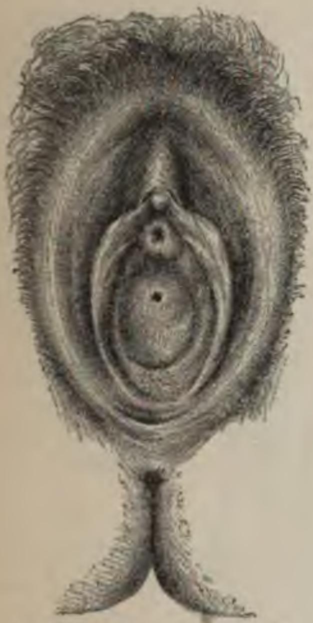

FIG. 65.—Diaphragmatic Hymen.

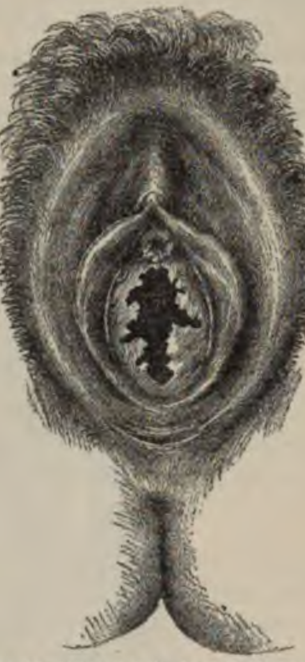

FIG. 66.—Fimbriated, Annular Hymen.

The imperforate hymen is a pathological condition.

Dohrn[2] gives the name "denticulate" to a variety in which the hymeneal opening is a more or less ragged slit with prolongations running from it and giving it a somewhat arborescent appearance. Fritsch,[3] in a study on these forms, describes one which we have not met elsewhere, an annular membrane with two dentations, situated laterally as regards the opening and running from it, directly out toward the base of attachment. He also describes many of the vices of development which we have noted. Dohrn's denticulate hymen is more common in young girls and children.

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[1] "Viol et Attentats aux Mœurs," Vibert, "Nouv. Dict. de Méd. et Chir. Prat.," vol. xxxix., pp. 484 and following.

[2] "Zeitschrift für Geb. und Gyn.," xi., i.

[3] Mueller's "Handbuch für Geburtshilfe," Bd. iii., pp. 667–673.

IS THE PRESENCE OF AN INTACT HYMEN EVIDENCE OF VIRGINITY?

While we are by no means ready to assert its invariable existence, we do maintain that it is incomparably the most valuable physical sign (Tourdes claims it is the only one), and further that when its orifice is undilatable, of small size, its edges are untorn, and when this condition is combined with a virgin state of the breasts and pudendum, in a nubile girl, the physician is amply justified in giving an opinion that the woman is *virgo intacta*. This is the opinion of the great majority of medical jurists from the days of Casper and Devergie. It is not, however, positive proof of the non-commission of rape, particularly in the case of young children where the membrane is deeply

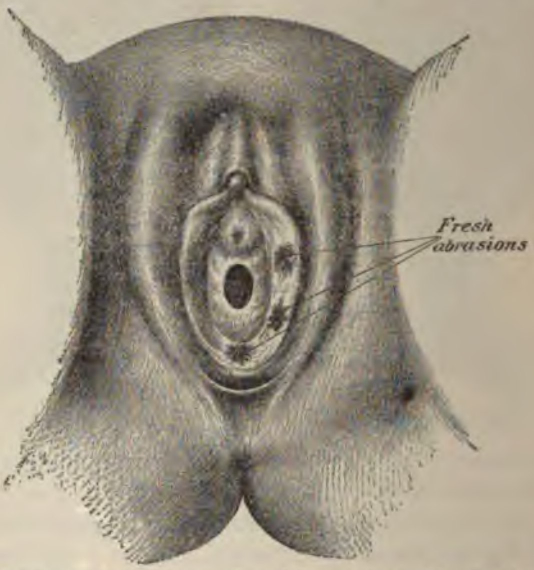

FIG. 67.—Case Illustrating Vulval Penetration of Recent Date. The vulval canal contains three *fresh* abrasions. The hymen is annular and intact.

situated and the organs undeveloped, since the *slightest penetration* constitutes the crime, as in the following case:

Vulval Penetration.—Examination of Stains.—A. B.; 15 years; American; no occupation; crime said to have occurred April 8th, 1894; examination April 9th, 1894, just twenty-four hours after alleged assault. General condition is good; genitals unusually well developed; vulval canal moderately deep with excessive secretion; hymen is of the annular variety and the opening in it just admits the tip of the index finger, and appears to have been recently inverted and stretched. Just within the fourchette, which is intact, is seen a fresh abrasion, and on the *left* wall of the vulval canal are seen two more, which stain with blood absorbent cotton pressed against the abraded surfaces.

A certificate was immediately given in this case of "a recent penetration of the genital organs by some blunt instrument." Absolutely no weight was given to the girl's story by the medical examiner, but upon the day of examination a sealed package containing a stained undergarment, removed from the child, was handed him. This was at once sent to Dr. John M. Byron of the Loomis Laboratory (Medical Department, University City of New York) for microscopic examination. He reported the next day as follows:

"The specimens contain vaginal cells in abundance and human spermatozoa, some in perfect condition, others the head alone. . . ."

Upon this case coming up for trial in the Court of General Sessions New York, the man pleaded guilty to rape and was sentenced to nine years in State's Prison.

An intact condition of the hymen alone is by no means an indication that coitus and impregnation have not taken place. It has been repeatedly found in prostitutes; in one notable instance reported by Duchatelet, an eminent French physician confessed his inability to determine whether two women, whose lives had been notoriously immoral for years, were virtuous or not.[1] Stolz[2] alleges that it may persist even after delivery, citing the case of a young woman in his own personal knowledge whose hymen was in the form of a loose ring. A case is also on record in which a five-months fœtus was delivered through an unruptured membrane. Budin alone has collected thirteen cases of primiparæ with perfect integrity persisting until confinement, and numerous others have been reported where division of the membrane was necessary before delivery could be

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[1] Guy's "Forensic Medicine," p. 49.

[2] Annales d'Hygiène, 1873, t. 2, p. 148.

The hymen[1] is a thin membrane stretched out over the entrance to the vagina and separating it from the external genitals. It has the same structure as the vaginal walls. It is, in fact, but a reduplication from them, formed of the same fibrous and elastic tissue with the vessels and nerves and covered by the same epithelium. Its situation is rather superficial in young women, much more so than in children. Its thickness varies from one to three millimetres (Tourdes[2]) and its consistence may be of any character from firm and almost tendinous to soft and elastic. Its orifice is not usually situated in the centre but nearer to the meatus (shown in accompanying colored plate), and in its normal condition will usually permit the passage of a finger into the vagina without rupture of the borders of the membrane.[3]

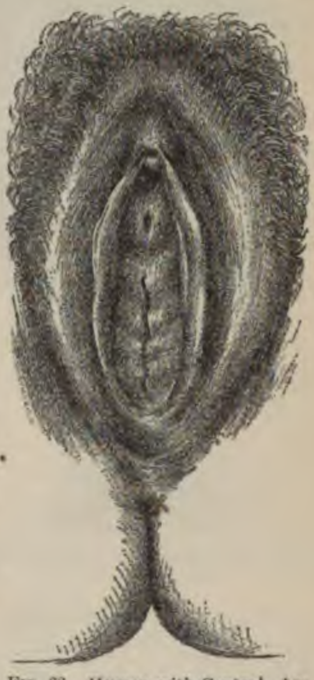
FIG. 62.—Hymen with Central, Antero-Posterior Slit.

It is due possibly to the numerous forms of arrested development, of vices of conformation which it presents, that its absence is so often stated.

There are four principal forms with numberless variations in each: the form of hymen with a central, antero-posterior slit, the semilunar, annular, and diaphragmatic. Of these, the first and third are more common.

The first variety consists of two folds, placed on either side of the opening with a central slit between them, running antero-posteriorly, like a buttonhole (Fig. 62). It is the usual shape in children. The semilunar fold is situated with its thickest portion at the posterior commissure and the horns running up the sides of the os vaginæ have indicated above, the whole group together by their presence make possible the assertion of virginity. The simulation of the state, for reasons which readily occur to the mind, is often attempted. The changes in the breasts during pregnancy cannot be hidden, but where this event and subsequent delivery have not taken place, many attempts have been successful in deceiving both the laity and the profession. An artificial narrowness and tonicity of the vagina and a certain, sometimes considerable amount of restoration of the hymen may be produced by the daily use of astringent injections. The pain and the bleeding resulting from first approaches (the latter by sponges, saturated with blood and placed in the vagina) are easily simulated. This is particularly frequent in countries, especially in the East, where absence of hemorrhage in the first intercourse is viewed with suspicion, and where the "bridal shift," stained with blood, is preserved by the relatives as indisputable proof of the antenuptial chastity of the bride.

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[1] Edin. Med. Journ., vol. xxiii., p. 906.

[2] "Viol et Attentats aux Mœurs," vol. iii., series 5, pp. 658–699, "Nouveau Dict. de Médecine et Chir. Prat."

[3] Lutaud: "Etude Méd. Lég. sur l'Hymen," Rev. de Méd. Lég., vol. i., 1–6.

DEFLORATION AND THE DISEASES AND OTHER CONDITIONS WHICH MAY SIMULATE IT.

Defloration may be complete or incomplete, following partial or full penetration by the penis. When complete, the signs of the condition show marked differences as they are recent or of ancient origin. We shall, accordingly, treat the subject under these heads.

Complete, Recent Defloration.—The most valuable proofs are furnished by the hymen as in consideration of the question of virginity, but there are certain appearances presented by other parts worthy of note. The *external genitals* will exhibit inflammatory symptoms varying from a slight sensitiveness to a swollen, hot, congested state so painful as to interfere seriously with the woman's movements. She will evince an instinctive dread also of opening the thighs, in the latter case. These two signs are of the greatest possible importance, since they are not likely to be imitated. If resistance has been offered to the assault, besides these injuries, there will be found marks of a struggle such as scratches, abrasions, and contusions, located most frequently in the neighborhood of the genitals, the thighs, abdomen, and perineum, but occurring exceptionally in any other locality. The degree of mischief will be directly proportional to the amount of force employed; this may be carried to such a point as to occasion extensive lacerations, rupture of the perineum, of the vagina even into the rectum. Ogston[1] relates the case of a woman violated by two men, who afterward thrust foreign bodies into her vagina. The recto-vaginal wall was broken down, and the woman died on the third day. Injuries of this nature are more prone to take place where the disproportion between the organs is great, as in rape on children, and when the man has pronounced virile power. One case (it seems to fall into the category of lust-murder) has been placed on record by Pénard,[2] where a woman of sixty had her perineum, vagina, and rectum extensively lacerated, part of the last being actually torn from her body. Internal injuries may be sufficient to cause death, with scarcely a trace to be found externally.[3] A girl of fourteen was raped by her master in England. The fourchette was torn but there was no evidence of penetration. She died in three weeks, and at the autopsy the right iliac vein was found blocked by a thrombus of septic nature and an ante-mortem clot in the aorta. The uterus was enlarged and coated inside by purulent exudation. This septic metritis supervened from filth and resulted in a systemic intoxication.[4]

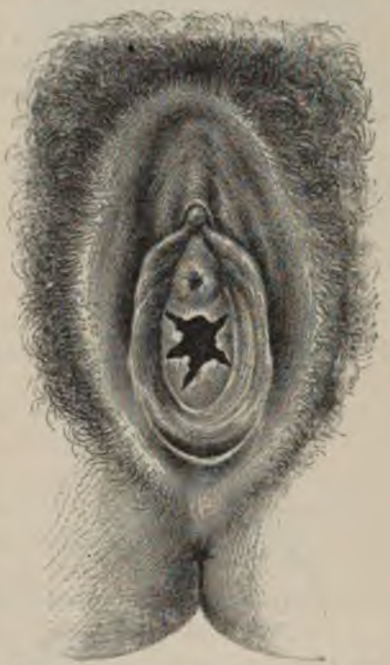

FIG. 68.—Stellate Laceration of Hymen in Adult.

Pain and difficulty in walking may be symptomatic of a *hymeneal tear* as well as vulval inflammation. The membrane can often only be brought into view by separating the thighs and labia so widely as to cause great suffering. For this reason, two examinations may be required before an opinion can be offered. Bleeding from the tear may be the first sign to attract notice and, in hæmophilic subjects, it may be sufficient to cause death. An example is furnished by Bordmann[1] of a woman who died from hymeneal hemorrhage on her bridal night. Vibert[2] claims that tears do not take place in any particular way, but various forms are described by others (Tourdes, etc.).

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[1] "Forensic Medicine," p. 117.

[2] Annales d'Hygiène, 1860, vol. xiv.

[3] Indian Med. Gaz., 1875, p. 284. —Dr. Harvey.

[4] Birmingham Medical Review, xxvii., pp. 216–220.

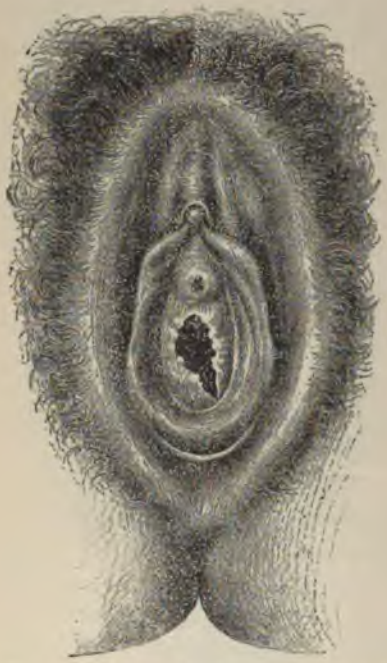

FIG. 69.—Left, Posterior Laceration in Annular Hymen of Adult.

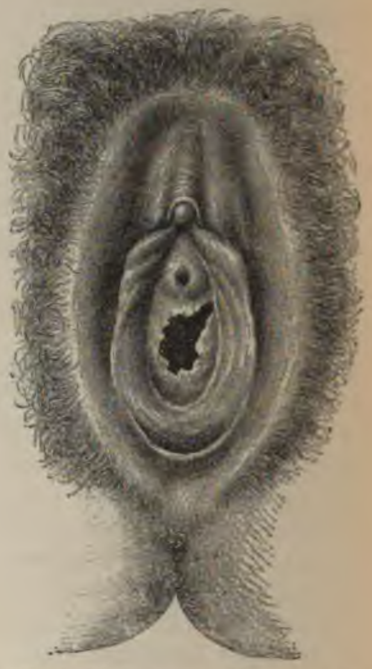

FIG. 70.—Left, Anterior Laceration of Annular Hymen of Adult.

The laceration is usually stellate, in four or five fragments, but changes with the form of the hymen. In the labial and semilunar forms, it is torn toward the base, generally to one side of the median line. The appearance and shape of the pieces should be noted, paying particular attention to the edges of the tear, which give valuable aid in determining the date of the attempt.

[1] Thesis, Strasburg, 1851.

[2] "Viol et Attentats aux Mœurs," "Nouv. Dict. de Méd. et Chir. Prat.," vol. xxxix., p. 484.

At first, these latter are bloody and fresh, later (one or two days) they show slight inflammation, in three or four days suppuration may appear. Healing is usually complete in eight to twelve days according to Toulmouche,[1] in twenty according to Tardieu.

It has been denied[2] that tears of the hymen ever unite, but Vibert agrees that they may, though very seldom; Brouardel[3] and Tourdes declare that they may heal perfectly, leaving only a trace. The cicatrix will be red at first, much the same in color as the rest of the membrane, but later it shows as a white line. The finger or a sound should be passed behind the hymen to draw it forward and obliterate any folds so that the entire surface may be in plain view. The *vagina* may join in the general inflammation and become the seat of a discharge such as will be considered further on.

Incomplete, Recent Defloration.—This is the condition generally found in assaults on children (see Rape on Children, *infra*) because of the disproportionate size of the organs involved not permitting complete intromission. Fimbriated edges of the hymen are difficult to distinguish from the slight tears resulting from a partially successful attempt at intercourse. A cicatrix, if it has not become whitened, may be overlooked; a cicatrix of a mucous membrane rarely does reach this state. The membrane may be so placed in folds as to entirely mask numerous lacerations. When a vulval canal is elongated, leading to a hymen with a fringed, unequal border, it is generally considered a sign of incomplete defloration; but this is not likely to be the result of a single attempt, and Brouardel[4] cites the case of three virgin sisters in whom this condition was congenital.

Non-Recent Defloration.—This is characterized chiefly by the absence of a complete hymen and the presence of its remnants. If cicatrization has been perfect, the lines may be brought out as described. The ostium vaginæ is of some diagnostic value, being, as a rule, dilated and patulous. The same condition may be found in the vagina itself. This was illustrated by a case given by Casper[5] in which this condition was found nine days after perpetration of the crime. The edges of the hymeneal tears will be found smooth and rounded from the formation of scar tissue. Dilatation of the vulva may add another sign to these, so as to make it possible for the examiner to affirm that a previous defloration has taken place without assigning any date for it.

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[1] "Des Attentats à la Pudeur et du Viol," Ann. d'Hyg., 1856, vol. vi., and 1864, vol. xxii.

[2] Tidy: "Legal Medicine," Am. ed., iii., p. 124.

[3] "Les Causes d'Erreur et Regles d'Expertise," etc., Ann. d'Hyg., x., pp. 60, 148.

[4] Ann. d'Hyg., vol. x., pp. 60, 148.

[5] "Forensic Medicine," New Sydenham Soc. Transl., vol. iii., p. 311.

An open, enlarged state of the vulval canal, with separation of the labia majora and loss of their plumpness, a lengthening of the nymphæ and change in their pink tint to a yellow or light brown, combined with a general flaccidity of the organs, indicate repeated indulgence in sexual intercourse. This statement will not apply in every case, in this connection any more than in the other conditions considered, for exceptions are always to be found. A prostitute has been examined in whom an almost virginal state of the parts remained after a life of shame, beginning at fifteen and extending over nearly forty years. The os and cervix uteri are not affected, like the breasts, by intercourse alone. The changes produced in them and in the remainder of the birth canal by parturition (treated in another chapter) are not useful in cases of rape, except as showing the previous loss of virginity.

Diseased Conditions Simulating Defloration.—Of the traumatic causes of defloration we have already spoken. It remains now to discuss the diseases capable of working such destruction as to resemble the result accomplished by intromission. All ulcerous and gangrenous affections of the pudendum may in their course destroy so much of the tissue that the normal configuration of the parts is lost. The chief ulcerous varieties of vulvitis[1] are the aphthous, the diphtheritic, the erosive vulvitis of Fournier,[2] which must be carefully distinguished from that due to traumatism attended by abrasions, from specific sores, chancre, chancroid, from mucous patches, and from herpes progenitalis. The importance of a differential diagnosis is shown by a case given in the *Medical Times and Gazette*, 1853, April 23d and 30th. A boy was accused of rape on a girl of four with whom he had been sleeping. She died from an inflammation of the vulva, after nine days. The defendant was

[1] Tourdes: "N. Dict. de Méd. et Chir. Prat.," vol. iii., series 5, pp. 658–699.

[2] Brouardel: Ann. d'Hyg., x., pp. 60, 148.

acquitted when it was learned that several other cases, with fatal issue, had occurred at the same time, where no such suspicion entered. The "inflammation" was probably noma, a gangrene of the genitals, attended by great destruction, systemic infection, and often ending in death. (For the differential points distinguishing these processes we must refer the reader to works on gynæcology and venereal diseases.)

A profuse and persistent leucorrhœa may obliterate the vaginal rugæ, dilate the canal and the os vaginæ, and finally cause superficial ulcerations of the mucous membrane, closely resembling those produced by coitus; excessive menstrual discharges may do the same. The diagnosis is extremely difficult and can only be made by closely following the course of the disease.

MARKS OF VIOLENCE.

Besides the signs of defloration, traces of a more or less violent struggle are generally to be found on the person of the victim. Their nature, ecchymoses, contusions, tears, scratches and their location on the external genitals, thighs, abdomen, and anterior surface of the body generally, will be found under signs of defloration. In a false charge, an endeavor will often be made to imitate them, and the examiner should be constantly on his guard. They will be superficial and located on parts of the body easily reached by the hands in the latter case. The shape and location of all such marks should be carefully described.

The difficulty in discovering signs of violation in women accustomed to sexual intercourse and in those who have borne children, is readily apparent. Medical proof[1] is obtained from the internal genitals only in exceptional circumstances, but occasionally marks do remain as when several men commit the rape. On the pudendum, we find signs resulting from efforts to introduce the penis; on other parts, the evidences described, but the statement requires modification in the face of cases such as the following: Two married women were assaulted and the crime completed in spite of their resistance, but no marks of violence were found in either case (Reg. *v.* Owen and others, Oxford Circ., 1839). Taylor[2] says "the vagina to decide. It had better be referred to the men who are thoroughly familiar with all its practical phases, and we shall abide by the opinion of the majority.

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[1] Vibert: "N. Dict. de Méd. et Chir. Prat.," vol. xxxix., p. 484.

[2] "Medical Jurisprudence," p. 662.

In 1879, A. Neisser reported a micrococcus peculiar to gonorrhœa which he found constantly in the pus; his investigations were confirmed by others, and in 1882 and 1889[1] he reaffirmed his previous belief. The cocci were inoculated in healthy urethræ and produced a typical disease. Finger[2] puts himself on record in its favor, unqualifiedly, going so far as to say that "if we have examined several, at least two to four, cover-glass preparations from an acute suppuration and have not found gonococci, the negative results exclude blennorrhœa." (The diagnosis is infinitely more difficult, of course, where the process is latent, the acute stage being passed, on account of the small number of organisms present.) Bumm, Saenger, and others concur in the opinion. Lustgarten and Mannaberg[3] have endeavored to cast suspicion on the diagnostic significance of the gonococcus, describing pseudo-gonoccocci which they claimed were identical, in the normal urethra, but they failed to show any real examples of this error. Steinschneider went over their ground and concluded that the Gram stain (*vide infra*) gives, in 95 per cent of cases, absolutely reliable results. Three or four kinds of diplococci have been found also in the normal vagina which bear close resemblance to the Neisser organism; but Koplik[4] (in 200 cases), Wertheim,[5] and Bumm[6] have not met any case in which the differentiation was not possible. Numerous authors[7] have examined pus from vaginal discharges, all with the uniform presence of leucocytes containing diplococci, identical with the descriptions of the gonococcus Neisser.

CHARACTERISTICS OF THE GONOCOCCUS.—This micro-organism possesses certain characteristics, all of which (Finger, *op. cit.*) must be present before the diagnosis can be made. The absence of any single one of them will throw doubt upon it. In *shape* they resemble coffee-beans, and being diploccoci are always in pairs or multiples of two, their flat or slightly concave alone may be the seat of violence," and in support of his statement cites an instance in which this was the only point of corroboration. The woman was half suffocated by having her clothes thrown over her head. If the charge were brought by a prostitute, it is likely that much more than medical testimony would be required to establish it.

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[1] Naturforscher - Versammlung, Strasburg.

[2] "Blennorrhœa of the Sexual Organs," 1894, p. 74.

[3] Vierteljahres. f. Derm., 1887.

[4] Journal of Cut. and Gen.-Urin. Diseases, vol. xi., nos. 129 and 130.

[5] Archiv f. Gynäk., Bd. xlii., 1892.

[6] Wiener Klinik.

[7] Cahen-Brach, Epstein, Fraenkel, Parrot, Kratter, Widmark, Pott, Spaeth.

Stains and Other Marks.—In another chapter on "Blood and Other Stains" (see Vol. II., pp. 7–88), the methods of examination, microscopical appearances, etc., are detailed at length. If defloration has been caused by the assault, blood will be found on the genitals, within the canal, on the thighs, clotting the pubic hair and soiling the linen, in case the act were recent. If emission was excited, seminal fluid can be demonstrated in the same locality. (Case cited, p. 429.) The presence of sperm indicates positively the completion of the sexual act; whether with consent or not, does not concern the medical jurist. According to Müller, the spermatozoa (Fig. 71) retain their motile power in the vagina for eight days. Bayard has found them[1] alive three days after coition and in stains after six years. Where ejaculation is said to have occurred, the vaginal mucus should be examined, not once, but repeatedly, to prove their presence. A severe leucorrhœa may destroy them in a very short space of time, and in certain diseased conditions an organism described by Donné, and called by him the *Trichomonas Vaginæ*, finds its habitat in the vaginal mucus. It resembles spermatozoa, but is distinguished by having a shorter tail and a much larger head. A committee appointed by the French Academy of Medicine, consisting of MM. Adelon, Moreau, and Le Canu, reported on the question of differentiation of menstrual and other blood[2] that there was at that time no

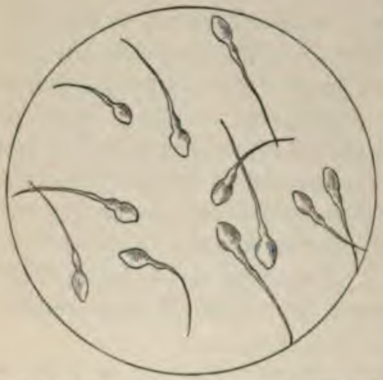

FIG. 71.—Human Spermatozoa. (Magnified 600 diameters.)

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[1] "Man. Prat. de Méd. Lég.," p. 277.

[2] Annales d'Hygiène, 1846, t. 1, p. 181.

method by which a certain decision could be reached. The improvement in method has brought us no nearer a solution of the problem. The linen and person of the woman may be stained by blood procured for the purpose in support of a false charge. An appearance of smearing and location of the stain on the outside of the stuff, without penetration of the whole thickness of the fabric, established the falsity of the accusation against a young man charged by a woman with having violated her child.[1]

Particles of dirt should be preserved. They may have been gathered up in the spot where the crime was committed and thus furnish valuable corroborative testimony; so with woollen or linen fibres which may have been detached from the garments of the ravisher. This brings us to the consideration of the stains resulting from discharges and venereal diseases produced in the woman by impure intercourse.

Vaginal Discharges — Leucorrhœa. — The frequency of a muco-purulent discharge in pure young women past the age of puberty has been repeatedly mentioned, as producing marked changes in the genitalia. It is a symptom merely, arising from chronic vaginitis, cervicitis, or endometritis. The secretion itself may be mucous, muco-purulent, or purulent. This last condition is the result of an exacerbation in the process, *e.g.*, after a rape or attempt at the first sexual intercourse. The discharge will stain the linen a light greenish-yellow. It has often been made the basis of a charge of rape and exhibited as grounds for divorce.[2] A history is usually obtainable on repeated and careful inquiry of the disease's long standing, its exacerbations and remissions. This discharge must be differentiated from the purulent secretion of gonorrhœa and from the slight discharge which commonly appears after defloration. The last has no period of incubation, beginning often in a few hours, a day or two at most, pursuing a mild course and terminating in eight or ten days or less. In gonorrhœa the period of incubation is four or five days; the symptoms gradually increase in severity, and weeks, six or more, are required for it to run its acute course.

Gonorrhœa. — Whenever a discharge is met with, the question instantly arises: Is it or is it not gonorrhœal? The vast importance of an answer to the query where a discharge exists in both parties need hardly be mentioned. (A mucopurulent discharge in both parties was found in eight of our cases; of these, two were pronounced gonorrhœal by the aid of the microscope.) It is not necessary that the secretion in the man shall be purulent, for it is a well-established fact that a chronic blennorrhagic urethritis in the male is capable of as much mischief as the pus referred to. According to Noeggerath (1872 and 1887), 80 per cent of all married women suffer from gonorrhœa, the result of the tendency of the disease in men to pass into a latent stage. His views have since been modified to a considerable extent, but they have been found in the main correct. Saenger[1] found gonorrhœa in 230 out of 1,930 women, and believes that one-eighth of all who suffer from disease of the organs of generation are victims of gonorrhœal infection. This is a moderate estimate. Full penetration is not necessary to transmission of the disease; the vulval mucous membrane is as sensitive to the infection as the vaginal or cervical.

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[1] Bayard: Ann. d'Hyg., 1847, t. 2, p. 219.

[2] Ligneau: Ann. d'Hyg., 1870, t. 2, p. 192.

The longer period of incubation and course will distinguish true gonorrhœa from the purulent discharge which follows defloration. Where a secretion exists, then, attended by inflammation, the examiner should never content himself with a single inspection. The differentiation from leucorrhœa is more difficult. The clinical characters, however valuable, do not permit the establishment of a diagnosis. The presence of urethritis is a most important sign in women as indicating the blennorrhagic origin of the discharge, but it is on the question of the etiological significance of the gonococcus that the whole question turns, and we shall consider it somewhat at length.

Dr. Lobert of Lille and Professor Klatter of Innspruck, both medical jurists of repute, declare that the finding of the gonococcus makes the medico-legal diagnosis of gonorrhœa. Vibert[2] does not admit its rôle without reserve, remarking that "in the actual state of our knowledge it is impossible." His deduction that, therefore, the expert is not justified in affirming the nature of a vulvo-vaginitis was agreed to by the Paris Medico-Legal Society. It seems hardly a question for legal medicine to decide. It had better be referred to the men who are thoroughly familiar with all its practical phases, and we shall abide by the opinion of the majority.

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[1] "Die Tripper-Ansteckung beim weiblichen Geschlecht," Leipzig, 1889.

[2] "Du Gonocoque en Méd. Lég.," Ann. d'Hyg., xxv., pp. 443–447, 1891.

In 1879, A. Neisser reported a micrococcus peculiar to gonorrhœa which he found constantly in the pus; his investigations were confirmed by others, and in 1882 and 1889[1] he reaffirmed his previous belief. The cocci were inoculated in healthy urethræ and produced a typical disease. Finger[2] puts himself on record in its favor, unqualifiedly, going so far as to say that "if we have examined several, at least two to four, cover-glass preparations from an acute suppuration and have not found gonococci, the negative results exclude blennorrhœa." (The diagnosis is infinitely more difficult, of course, where the process is latent, the acute stage being passed, on account of the small number of organisms present.) Bumm, Saenger, and others concur in the opinion. Lustgarten and Mannaberg[3] have endeavored to cast suspicion on the diagnostic significance of the gonococcus, describing pseudo-gonoccocci which they claimed were identical, in the normal urethra, but they failed to show any real examples of this error. Steinschneider went over their ground and concluded that the Gram stain (*vide infra*) gives, in 95 per cent of cases, absolutely reliable results. Three or four kinds of diplococci have been found also in the normal vagina which bear close resemblance to the Neisser organism; but Koplik[4] (in 200 cases), Wertheim,[5] and Bumm[6] have not met any case in which the differentiation was not possible. Numerous authors[7] have examined pus from vaginal discharges, all with the uniform presence of leucocytes containing diplococci, identical with the descriptions of the gonococcus Neisser.

CHARACTERISTICS OF THE GONOCOCCUS.—This microorganism possesses certain characteristics, all of which (Finger, *op. cit.*) must be present before the diagnosis can be made. The absence of any single one of them will throw doubt upon it. In *shape* they resemble coffee-beans, and being diploccoci are always in pairs or multiples of two, their flat or slightly concave surfaces toward each other. They are never found in chains, but always in *groups*, owing to their method of division. Within these groups, two pairs are usually close together, sarcina-shape. Their most characteristic attribute is their behavior with *stains*. They readily take up anilin dyes, but they part with them also more easily than other cocci. This property suggested what is known as the Gram method, in which a cover-glass preparation of the pus (a drop or two dried on the glass) is stained with an aqueous solution of gentian-violet, fixed in solution of potassium iodide for one minute, washed in water, then in 95 per cent alcohol, which causes decolorization, and finally counterstained with a watery solution of fuchsin. The gonococci appear red and other micro-organisms are dyed a deep blue. As to *position*, the groups of cocci are always found in the protoplasm of pus-cells. The cell may contain so many as to be completely distended with them. Their habitat in the cells is proved by their focusing under the microscope at the same level with the cell nuclei. They may be found also inclosing nuclei with no appearance of cell-wall. The pairs lie closer together near the centre of the masses which have been produced in the destruction of the host by the parasites. The discovery of a few diplococci in cells does not prove that the discharge is a gonorrhœa; their *number*, when pus is present, should be thousands (Fig. 72).

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[1] Naturforscher - Versammlung, Strasburg.

[2] "Blennorrhœa of the Sexual Organs," 1894, p. 74.

[3] Vierteljahres. f. Derm., 1887.

[4] Journal of Cut. and Gen.-Urin. Diseases, vol. xi., nos. 129 and 130.

[5] Archiv f. Gynäk., Bd. xlii., 1892.

[6] Wiener Klinik.

[7] Cahen-Brach, Epstein, Fraenkel, Parrot, Kratter, Widmark, Pott, Spaeth.

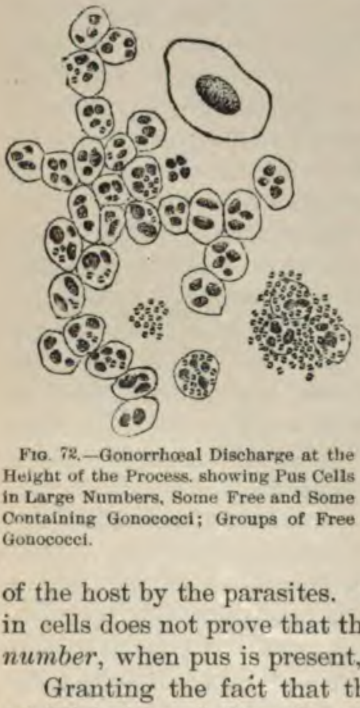

FIG. 72.—Gonorrhœal Discharge at the Height of the Process, showing Pus Cells in Large Numbers, Some Free and Some Containing Gonococci; Groups of Free Gonococci.

Granting the fact that the nature of a discharge has been established by finding the cocci with these attributes, it does not follow that it might not have been produced in some way other than by impure intercourse. Not a few cases illustrative of this are reported,[1] but we shall content ourselves with one, given by Ryan.[1] Two sisters, aged one and four respectively, were infected by being washed with a sponge which had been used by a servant suffering from a profuse discharge. The habits of herding and of uncleanliness, so common in the tenements of our great cities, are strikingly conducive to the spread of such affections, particularly among children.

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[1] Koplik: Journal of Cutaneous and Genito-Urinary Diseases, vol. xi., nos. 129 and 130.

Syphilis and Chancroid.—A certain amount of vulvitis, attended by discharge, may be the result of specific ulceration. The secretion should be cleared away and the appearance of the sore, its edges, base, neighboring induration noted. Inguinal, glandular enlargement may be present to aid in the diagnosis. The glands will be hard and painless in syphilis; softer, approaching later fluctuation (a symptom produced by the presence of pus) and so painful often as to interfere seriously with motion, in chancroid. The initial lesion in the former is hard and shotty to the touch, as though of something set in the skin or mucous membrane, has a crater-like form with sharply defined margins and a base covered with slight exudation; the ulcer of the latter has little induration, its edges are undermined, its base worm-eaten and covered with thick secretion. The typical appearance of either may be masked by the presence in the sore of the virus of the other, constituting what is known as a mixed infection (it is generally believed that the virus of chancroid, although it has not been isolated, is peculiar to itself). The importance of a second examination is even greater in this case than when dealing with a discharge. The period of incubation of syphilis after exposure before the appearance of the chancre is variously stated at from ten to seventy days, the average interval being three weeks. Its course is slow, but it heals after a time, leaving, in a majority of cases, a pigmented spot which gradually disappears; if the process extends beyond the superficial layers, a scar results. It seats of predilection in the female are the labia, fourchette, and, not infrequently, the cervix uteri, where from its painless character, it often passes unnoticed. This is the stage of syphilis called primary. During a second period of incubation, constitutional infection occurs, which is followed, in six or seven weeks after the appearance of the primary sore, by an outbreak of secondary accidents, eruptions on the skin, showing first on the abdomen, outbreaks on the mucous membranes, nocturnal headaches and fever, multiple glandular enlargements, etc. This is the secondary stage of the disease, during which the secretions are most contagious. It continues for two years, approximately, and merges gradually into the so-called tertiary period, in which the lesions are generally not contagious, although secondary accidents often continue to occur, retaining their full virulence on inoculation. The disease, however, pursues its mischief-working in the body, unless checked by treatment, attacking any and all parts. It is during the secondary period and then only[1] that a positive diagnosis can be made after the first appearance of a sore. Chancroid has no fixed period of incubation, is attended by no such sequelæ, being a purely local process, and healing with rapidity under local measures alone. Both chancre and chancroid must be distinguished from other non-specific ulcerations of the genitals, from herpes and mucous patches, secondary syphilitic manifestations. Hamilton[2] and Lowndes[3] have reported three cases of syphilitic infection during rape, and two others are cited by Ogston.[4] The terms primary, secondary, and tertiary are now falling into disuse among syphilographers, being replaced by the words early and late in reference to the manifestations of the disease.

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[1] London Medical Gazette, vol. xlvii., p. 744.

It is not necessary to reiterate the injunction that both accuser and accused must be examined, in the presence of gonorrhœa or syphilis. (1) For, if found in either and not in the other party, it is presumptive evidence of the falsity of the charge. (2) If, after a sufficient time of incubation in either case of disease has elapsed, both persons are discovered to be suffering from it, it is corroborative of the truth of the accusation, but (3) if the female exhibits the secondary or tertiary signs of syphilis or a gonorrhœa of a fortnight's or longer duration, as evidence of her allegation, at an examination instituted shortly after the rape, her chastity may be called in question and her accusation thereby invalidated to a great extent.[5] Both diseases may be acquired by accident, it must be said, the chancre of syphilis occurring extragenitally anywhere. Chancroid is not so valuable as the other two venereal diseases, owing to its variable time of manifestation after exposure. The time of the rape and examination must be definitely settled, in order to insure the stability of any of this testimony.

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[1] See Fournier: "Leçons Cliniques sur la Syphilis" (p. 286, for differential diagnosis).

[2] Dublin Medical Press, 1853, May 4th, p. 276; one case.

[3] Med. Press and Circular, 1884, vol. ii., p. 455; two cases.

[4] "Lectures on Med. Juris.," p. 96.

[5] Tidy: "Legal Medicine," Am. ed., vol. iii., p. 127.

Accidents Following Rape.

Beside the accidents of disease and deformity of the organs produced by it and laceration (provided for in the Austrian and German Codes), the effect upon the health and mind of the victim may be most disastrous. Convulsions have been known to succeed the attempt, or a delirium in which the man and the whole scene pass again through the sufferer's disordered brain. Despair over the loss of her fair name and chastity may end in melancholia, in turn changing to suicidal mania. The shock to the system is sufficient to ruin forever the health in some cases and hurry the woman into an early grave. Hysteria, chorea, epilepsy even, are in the train of consequent nervous disorders. The attempt at violation is often the drop which makes the glass overflow.[1] Krafft-Ebing has recorded three observations in which epilepsy was the result of the crime.

It seems hardly credible[2] that there should ever have been a question raised as to the possibility of pregnancy following rape. The belief in the contrary has been a deep-rooted one, securing acquittal in one instance of trial for rape, but ovulation and impregnation are independent of the will, and if the organs are in proper condition of receptivity, fecundation will take place. The reports[3] of cases of this result of an assault have become so numerous that we can narrate the details in two only. In the first[4] the woman conceived after a rape committed on her, and the man afterward married her; her period of gestation lasted just 263 days from the date of the intercourse, definitely fixed by the charge. Stolz[5] has reported one case at length. A case celebrated in English law, Bromwich *v.* Waters,[6] we shall refer to again in another connection. Ryan's report, referred to, deals with a young woman who was impregnated while in an unconscious condition from intoxication, silencing those who believe that the will of the woman is a necessary adjunct to conception. Married women and others are known to become pregnant often when nothing is so far from them as the desire to find themselves in a delicate condition. Signs of pregnancy were found three times in our series of 176 cases.

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[1] Brouardel: "Accidents Consécutive au Viol," Gaz. des Hôpitaux, vol. lx., p. 1,096.

[2] Tourdes: "Nouv. Dict. de Méd. et Chir. Prat.," vol. iii., series 5, pp. 658–699.

[3] Ryan: "Med. Jurisprudence," p. 245. Tardieu, case 35. Edin. Monthly Journal, Dec., 1860, p. 588.

[4] London Med. Gazette, vol. xliv., p. 48.

[5] Annales d'Hyg., 2d series, vol. xl., 1873.

[6] Chester Lent Assizes, 1863.

We have spoken, under the head of Complete Defloration, of a death which resulted from the inordinate use of force in effecting the connection. It seems that the injuries could hardly have been caused by efforts at intromission alone; the man must have used his hands to make such frightful lacerations. Among our own cases, we shall relate one in which an eight-months baby was torn in the same way (into the rectum) by her father's hands to permit intercourse. In another place, under the head of Defloration, we have recalled a case where death was due to septic poisoning following rape. The perpetrator was indicted for murder, but pleaded guilty to attempt and was sentenced to seven years' penal servitude.[1] The famous case of Amos Greenwood[2] is part of the inheritance of legal medicine. Dr. Harvey[3] states that the issue was fatal in 5 cases out of 205 of rape recorded by him, and occurring in Hindostan. Other instances will be found in the works of Tardieu, Taylor, and Casper.

Death, consequent upon rape, may be the result of various causes, a fact clearly brought out in the cases just cited. It may supervene, without violence, following syncope produced by the emotion which the commission of the crime provokes.[4] The congestion of the brain and spinal cord, of the organs of generation, may be followed by fatal hemorrhages into their substance or neighboring cavities. Not only the wounds themselves, but their after-effects and the resulting condition of surgical shock may induce a lethal outcome. The penis of a well-grown, vigorous man may inflict such physical injuries on a child as are almost beyond belief. Dr. Brady's case[5] shows what their nature may be. A child of eleven, raped by a soldier, was found after twenty hours, in a condition of collapse, the external organs violently inflamed. She died in a few hours, and at the autopsy the vagina was found greatly dilated and torn from its attachment to the cervix uteri, with an opening into the abdomen, into which some blood and serum had been extravasated. (Might not, however, these lacerations have been the result of the use of the soldier's fingers for dilating the girl's passages?)

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[1] Birmingham Medical Review, xxvii., pp. 216–220.

[2] Med. Times and Gaz., 1859, pp. 361 *seq.*

[3] Indian Med. Journal, 1875, Nov. 1, p. 284.

[4] Brouardel: Gaz. des Hôpitaux, p. 1,069, vol. lx.

[5] Med. Gaz., vol. xxvi., p. 160.

This brings us to the consideration of the question of **Lust-Murder** as regards the victim solely. Murder may, of course, accompany rape without intention on the part of the ravisher, or it may be done to destroy the only witness of the crime, but it is only when it is perpetrated in order to gratify perverted sexual desire that it can be called lust-murder.[1] The presumption of this crime is safe "when the injuries to the genitals are such as could not be explained by merely a brutal attempt at coitus; and still more when the body has been opened or parts (intestines, genitals) torn out and wanting." The perverted passions may impel the criminal even to anthropophagy, a subject too disgusting for consideration. Occasionally, the murder alone suffices for the sexual gratification and the victim is not violated. Verzeni's case, given by Lombroso, in which the life of the woman hung on the early occurrence of ejaculation,[2] is a typical one. The violence becomes equivalent to coitus. The celebrated Whitechapel murders in 1888 and 1889 are the best examples of this form of perverted sexual gratification (sadism) in our day. The bodies of ten prostitutes who had keen killed were found with the uterus, ovaries, and labia wanting, beside other mutilations.[3] The absence of these organs would indicate that the criminal was addicted as well to anthropophagy. Other cases illustrating the points mentioned will be found in the works of the authors whom we have quoted.

CONSENT AND ABSENCE OF WILL.

Can a Woman be Violated Against her Will?—This question is one which has been debated with more or less acerbity since the infancy of medical jurisprudence. The views we express are those of a majority of writers (Tidy, Taylor, Tardieu, Casper, Brouardel, Vibert,[1] etc.). There seems to be no hesitancy in saying that a fully matured woman, in full possession of her faculties, cannot be raped, contrary to her desire, by a single man. The relative robustness and physical development of the parties must not be lost sight of, and, further, the woman may swoon from the excess of her emotions and violence of her struggles. A child or a woman in the hands of two or more men may fall an easy victim to their lust. When the female is young and more or less ignorant of what is going on, or when she is an old woman, enfeebled by age or an invalid, or when taken by surprise or firmly held, perhaps bound, or made submissive by threats of death, the act[2] may be accomplished. Fraud may be made to serve the purpose of the ravisher, as in case of his passing himself for the woman's husband (an instance to be given later). When only slight traces of a struggle are found on the thighs and breasts, it cannot be affirmed that the plaintiff has used all her strength in her defence, if she is young and healthy; for a certain class of women, willing enough in point of fact, make a point of a show of resistance before yielding, and, on the other hand, light pressure in those parts of the female form is often sufficient to determine an ecchymosis. Terror alone will produce with certain people a perfect functional paralysis rendering them as incapable of voluntary movement as the most complete paraplegia.

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[1] See Krafft-Ebing: "Psychopathia Sexualis," pp. 62 and 397; and Lombroso: Goltdammer's Archiv.

[2] *Op. cit.*, Bd. xxx., p. 13.

[3] Spitzka: Journ. of Nervous and Mental Disease, Dec., 1888. Kiernan: The Medical Standard, Dec., 1888.

Can Rape be Accomplished during Natural Sleep?—We think it unlikely—impossible in the case of a virgin. A married woman, or one habituated to sexual intercourse, in the state of semi-unconsciousness preceding or following deep sleep, may permit the embraces, but the cases appear to us more than doubtful. One instance, to which we have referred in other connections, will serve to illustrate our meaning. A man held sexual intercourse with a married woman, during sleep, withdrawing from her just as she waked. She admitted being conscious of the act and that she had asked who it was, suggesting certainly a reasonable suspicion of her marital fidelity at least.[3] In the York Autumn Assizes, 1854, a case (Reg. *v.*

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[1] "Précis de Médecine Légale," p. 307.

[2] Brouardel: "Accidents Consécutive au Viol," etc., Gaz. des Hôp., vol. lx., p. 1069.

[3] Casper: "Gerichtliche Medicin," vol. ii., p. 574.

Clarke) was tried, in which the man had connection with a married woman who had borne three children. She was in a half-waking state and supposed him to be her husband. The judges decided that "the act of intercourse did not amount to rape, because it was done with the consent of the woman." Fraud, rather than sleep, seems the instrument of crime here. Conviction followed in a similar case.[1]

A nice legal point arising in this connection is discussed by Tidy.[2] Is it consent if a woman in this somnolent condition, the room being dark and she supposing the man to be her husband, permits him to embrace her sexually? Decisions have been rendered in English courts in the negative (Reg. *v.* Young,[3] Reg. *v.* Mayers[4]), and in the affirmative (Reg. *v.* Saunders,[5] Reg. *v.* Williams,[6] Reg. *v.* Barrow[7]), although that consent was obtained by fraud. A number of judges[8] have denied the correctness of the decision in the last case, since they do not accept the dictum that "where consent is obtained by fraud, the act does not amount to rape."

Rape by Fraud.—Whether it is due to the ease with which the end may be accomplished in some cases, or whether the constant exposure to temptation induces a perversity of moral sense, whatever may be the cause, this phase of the crime finds an unpleasantly wide prevalence among medical men.[9] One of the earliest, recorded cases occurred in England in 1850.[10] A physician had carnal connection with a girl of fourteen who was ill from suppressed menstruation, he telling her that it was a necessary part of the treatment, and she, from her youth, being ignorant of the meaning of the act. He was convicted of rape. In the case of Reg. *v.* Stanton,[11] intercourse was effected by a physician under the pretence of giving an injection. Conviction followed. In that of Reg. *v.* Flattery,[12] the victim was an epileptic girl of nineteen. The doctor told her some ridiculous story of internal adhesions which must be broken down by a surgical operation, covering his purpose by that means. Turning to American reports, in the cases of

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[1] Edin. Monthly Journ., vol. ii., p. 74.

[2] "Legal Medicine," Am. ed., vol. iii., pp. 118, 119.

[3] 14 Cox, 114.

[4] 12 Cox, 311.

[5] 8 C. and P., 265.

[6] 8 C. and P., 286.

[7] L. R. 7, C. C. R., 156.

[8] Tidy, *op. cit.*, p. 119.

[9] Med. Rec., vol. xxvii., p. 34, 1885.

[10] 1 Denison's Crown Cases.

[11] 1 C. and K., 415.

[12] 2 Q. B. D., 410.

Santiago Don Moran *v.* People[1] and State *v.* Pomeroy[2] both the defendants were found guilty, but in the first, the decision was reversed on the ground that no force was used, and a new trial was granted. Compared with the vast total of rapes of all kinds, this particular form is infrequent, but next to the ruse of impersonating a husband, the most common fraud is the medical.

Rape during Unconsciousness from Narcotism, Alcoholism, and Anæsthesia.—While admitting the possibility of the accomplishment of violation under these conditions, the cases individually must be regarded with extreme suspicion. Chloral-hydrate, opium and its alkaloids, Indian hemp, tobacco, and other *drugs* have been used to further the end of the ravisher. The nature of the substance used is of little moment; the law regards intercourse as rape, when narcotics and intoxicating liquids have been administered, by or with the collusion of the accused, for the purpose of effecting the said connection. Narcotics act slowly, it must be remembered, and, particularly at their first administration, often produce vomiting. Suspicion should be instantly awakened[3] in any such case when it is claimed that unconsciousness immediately supervened.

The circumstances are to be taken into consideration in cases of *intoxication*. When a woman deliberately accompanies a man to a room, drinks until she becomes unconscious, and is raped, the crime is by no means so heinous as when a child is dosed with alcoholics.[4] In Reg. *v.* White (Northampton Winter Ass., 1856), the judge said that some doubts were entertained in law whether a rape could be committed on a woman who had rendered herself incapable of making any resistance by drink; he thought it no excuse for the man. The prisoner was convicted of indecent assault. The administration of "any drug, matter or thing," with intent to have carnal connection with a female is (by 48 and 49 Vict., c. 69, s. 3) a misdemeanor. This statute covers the administration of aphrodisiacs.

Statements of the immediate supervention of unconsciousness from *anæsthesia* are no more worthy of credence than from narcotism. Every man who has administered ether and chloroform knows the difficulty of giving them, the struggles of the subject from a sense of oppression and suffocation. Dolbeau,[1] in a series of experiments on adults in the Paris hospitals, could not obtain in a single case a passage from natural to anæsthetic sleep. This is not the experience in New York City hospitals, certainly so far as infants under chloroform are concerned. Granting the administration, a slight degree of anæsthesia will probably greatly facilitate the perpetration of the rape. A French dentist was found guilty of the crime on a woman to whom he had given ether. She claimed that, while she was perfectly conscious of what was passing, she was unable to cry out or resist.[2]

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[1] 25 Mich., 356.

[2] 94 Ind., 96.

[3] Brouardel: "Accidents Consécutive au Viol," etc. Gaz. des Hôp., vol. lx., p. 1,069.

[4] Reg. *v.* Camplin, 1 Den. C. C., 89.

A number of interesting cases have hinged upon the administration of nitrous oxid by dentists. Nothing is more frequent than the erotic dreams provoked by anæsthesia, especially by gas, and the hallucinations are so vivid as to lead to charges against the physician, in spite of the presence of witnesses. A certain element, not of untruth exactly, but of self-deception, hallucination by the woman, runs through all the reports which we have been able to collect. A case, Com. *v.* Beale, which was tried in Philadelphia in 1854, and which Reese[3] gives in full, ran substantially as follows. (It has been so often quoted that the briefest notice is really more than enough.) A young woman, just at her menstrual period, about to be married, was accompanied to a dentist's office by her betrothed. She inhaled the gas twice at his request, made an appointment for another day, and left without making a complaint. That evening, she alluded for the first time to the alleged rape, stating that she felt the dentist "enter her person," but she was unable to cry out or resist. The defendant was convicted and imprisoned for a term of years. She was never examined by a physician, and there is no doubt that the charge was false. A remarkable case, illustrative of this erotic excitement, occurred in Montreal in 1858. A woman persisted in the statement that a dentist had violated her while under the influence of gas, despite the sworn statement of her husband who had stood by during the operation. In another case[1] the assault was alleged to have been committed on a woman who was presumably a virgin, and was followed by pregnancy. Taking into consideration the rapid disappearance of the effects of nitrous-oxid anæsthesia, it is hardly credible that a virgin could have endured the pain of first intercourse without having been brought suddenly to her senses. In Reg. *v.* Snarey (Winchester Lent Ass., 1859) the falsity of the charge admits of no doubt. The plaintiff alleged that she became instantly insensible on having her face covered by a handkerchief in the hands of the accused. An *alibi* was clearly proved.

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[1] Société de Méd. Lég., Nov. 10th, 1873.

[2] London Med. Gaz, vol. xl., p. 865.

[3] "Med. Juris. and Toxic.," p. 559.

Rape on Psychopathic Individuals.—It has been decided by recent cases, both in this country and in England, Reg. *v.* Fletcher,[2] that, in diseased mental conditions not reaching complete idiocy, if consent is given and no force employed, the crime is not a rape. When, however, a state of unconsciousness from dementia or imbecility places the woman at the mercy of the ravisher, carnal intercourse is regarded as rape.[3] The point is clear that, in any charge, whether the woman is an idiot or not, some evidence must be adduced to show that connection was without her consent.

An accusation, based on an alleged act of violation during an *epileptic fit*, should be received with the same doubt as one in which gas was the instrument of lust. The case[4] of Dr. Bradley, of Birmington, England,[5] shows how an unfortunate man may suffer from such a charge. He was accused of two assaults on the wife of a collier, one on a chair and one on the floor. No evidence was found on the person of either. The defence claimed that the woman was an epileptic and that her delusion was the effect of a seizure. He was convicted of attempt only, in the face of her testimony, clear evidence of the doubt in the jury's minds.

Rape in Hypnotic States.—This is a subject which has received little attention and less credence at the hands of English and American forensic jurists, who usually content themselves with the trite remark, that "they are not all asleep who have closed eyes." Like other theories and investigations received at first with ridicule, hypnotism has been placed on a sure scientific basis, thanks to the labors of Charcot and his successors. It has found a place in French, Austrian, and Hungarian law and must, sooner or later, creep into the Anglo-Saxon. The great French experts in legal medicine, so far as we know, without an exception (Tardieu, Devergie, Brouardel, Vibert, Tourdes, Tourette), recognize the possibility that the will may be entirely abolished under hypnotic influence. The opportunity for malingering is great; that is seen at a glance, but the evidence in any charge of rape needs the most careful sifting. Only neuropaths, *i.e.*, women who suffer from some nervous taint either in themselves or in their parents, are subject to magnetic influence, according to the theory of the school founded by Charcot. They should always be examined by an expert neurologist for evidence of mind disease and for the hysterical complex of symptoms,[1] *globus hystericus*, localized areas of anæsthesia, amblyopia, etc. The crime is not frequent, but it undoubtedly exists in a small number of authentic cases.[2]

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[1] Lancet, 1886, vol. i., p. 361.

[2] L. R., 1 C. C. R., 39.

[3] 48 and 49 Vict., c. 69. Reg. *v.* Ryan, C. C. C., 2 Cox, p. 115.

[4] Other cases. Casper, case L, p. 307, and Reg. *v.* Baker, C. C. C., 1872.

[5] Lancet, 1885, vol. i., p. 165.

A trial for rape was held in the Rouen Assizes (1878), known and celebrated in French annals as the case of Berthe B. and the dentist Lévy. Brouardel[3] was called to examine the girl and made an exhaustive report. She presented symptoms of hysteria, anæsthesia of the genitals, etc., and the hypnotic condition could be easily produced in her. The decision of the medical examiners was that the state of nervous sleep really existed, and that a girl might be violated while her will is abolished by this means. The young woman was raped in the dentist's chair in a horizontal position, according to his own confession, but he claimed, at the same time, that she was a willing party. This she vehemently denied, saying that the defendant had rubbed her gums with some substance, and that in a few minutes she passed into a deep sleep. When she recovered consciousness, she felt pain in her genitals and there were bloodstains on her thighs. Her mother remained in the room during the whole time, and did not interfere, although she must have heard her daughter cry out. Lévy was convicted, largely upon his own avowal of guilt. It is possible, of course, that the intercourse took place with the girl's consent, but as the hypnotic state is capable of producing perfect insensibility of all kinds, there is no reason to suppose, as Taylor suggests,[1] that she would have been aroused by the pain. This view is confirmed by Devergie[2] in a case in which he was the expert. The element of doubt is, however, much stronger in this last. A girl of eighteen, after visiting a therapeutic hypnotizer daily for some little time, found herself shortly pregnant, and lodged a complaint against the man. On examination, her pregnancy dated back four and one-half months, to the time of her visits, and the possibility of the occurrence as she stated it was recognized. No mention seems made of the fact that impregnation might have been the result of intercourse between the visits.

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[1] Brouardel: "Accidents Consécutive au Viol," Gaz. des Hôp., vol. L., p. 1069.

[2] Tourette: "L'Hypnotisme au Point de Vue Médico-Légal," Paris, 1887.

[3] "Accusation de Viol dans le Sommeil Hypnotique," Annales d'Hyg., vol. i., pp. 37–59.

An understanding of the modern ideas with regard to hypnotism, aside from any theory as to the nature of its basis, is necessary to a complete mastery of the subject. Charcot recognized three magnetic states, lethargy, catalepsy, and somnambulism, the first two differing from the last in symptomatology, a classification recognized by all schools. Lethargy and catalepsy are closely allied. Every intellectual and muscular power, while they continue, disappears, but in somnambulism the faculties are on the alert though wholly under the control of the hypnotizer. In all three, there is complete loss of memory of events which took place during the sleep, on waking. The memory recurs in succeeding states, however, so that the crime may be described while the subject is under hypnotic influence at some subsequent date.

Lethargy and catalepsy are more favorable to criminal purpose, since the girl is absolutely without power to resist. The case of Berthe B. falls under this heading, as well as one reported by Auban and Roux (1865) in which the rape was repeated in succeeding states, and three others collected by Tourette.[3] Several of the victims were virgins whose defloration was followed by the usual pain and bleeding, in two by pregnancy. In somnambulism, force may be necessary to accomplish violation, very different from the preceding condition. Dyce[4] relates how a woman in spontaneous somnambulism was overcome by violence. Another instance is given by Bellanger in which the sexual relations of a doctor and his patient were kept up only during this hypnotic state. The knowledge of the condition of affairs was finally revealed to the girl's mother in one of the séances. Rape may be perpetrated in the analogous states of natural or spontaneous somnambulism (just referred to), hysterical lethargy, and catalepsy. In an hysterical subject attacks of ecstasy and of sleep may be produced by pressure on what are known as "hysterogenic zones," such as the abdomen over the ovaries, the inside of the thighs, etc. Tourette (*op. cit.*) gives one case of a girl seized by the thighs, thrown into lethargy, and violated, and Mabille[1] cites another. An interesting report is given by Brouardel (Assizes of Seine, June 17th, 1886) of a girl of twenty-three raped during an hysterical crisis, who became *enceinte*. Her attacks began at the time of her father's death and were typically hysteric, the intellectual powers being in complete abeyance. The accusation was abandoned by the public prosecutor.

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[1] "Med. Jur.," 11th Am. ed., p. 665.

[2] Gaz. Méd. de Paris, and Edin. Monthly Jour., 1860, vol. ii., p. 566.

[3] "Le Viol dans Hypnotisme," Ann. d'Hyg., 1886.

[4] Edinburgh Philosoph. Transactions.

Tardieu has ably treated[2] of simulation in these states. Simulators are often easily hypnotizable and of neurotic taint, as well as women whose statements may be perfectly true. It should be noted whether the sleep is profound enough to permit perpetration of rape and whether the lapse of time is sufficient. The attacks may be very transitory.

In summing up this subdivision of our work we may use the words of Tardieu on page 88 of the work to which we have referred in the preceding paragraph: "The unconsciousness of the woman can be reasonably admitted only in certain conditions, physical or moral, capable of preventing her from the free exercise of her senses, such as sleep, magnetism, or some nervous state, or in conditions causing abolition of conscience and memory, like idiocy, imbecility, or insanity, or even in certain states which constitute a veritable mental and moral infirmity like that of the deaf and dumb." With the addition of the unconsciousness of syncope, this sentence covers the ground completely.

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[1] Annales Méd. Psych., 1884, p. 83.

[2] "Etude Méd. Lég. sur les Attentats au Mœurs," 1878.

FALSE ACCUSATIONS—SIMULATIONS.

The disproportion between true and false charges is undoubtedly due in great measure to the fact that the sympathies of juries and of the public are commonly with the plaintiff. Imputations, often preposterous on their face, are accepted in the easy belief that the man must have been to blame. Brouardel[1] furnishes us with a brilliant example of this peculiar and unfortunate condition of affairs. A young, hysterical girl brought a charge of rape against an innocent man, and surrounded and shielded by an influential family, she pushed it to his conviction, relating, over and over again, the minutest details of the assault as she imagined it. Her statement was full of manifest discrepancies, and the physical conditions which she described were simply impossible.

We have had much to say already in discussion of simulation in other connections and shall not repeat it here. There is often no material proof of the deed, no evidence to be obtained from the persons of either the accuser or the accused. This negative evidence is of value, going far to invalidate the unsupported testimony of the female, as in the accusation of attempt by a girl of fourteen, Alphonsine M., against her uncle.[2] She was a neuropath, of notoriously bad character and suspected of unchastity, though this was not proven. She and her uncle had been drinking together. She suddenly ran out in the garden, crying that he had attempted an assault upon her, and soon after showed unmistakable signs of intoxication, vomiting, unsteadiness of gait, etc. The man was rescued from the infuriated neighbors, tried, and escaped conviction on the evidence of the girl's bad character. She was, at the time and previously, suffering from a discharge, while none could be discovered in her uncle.

If it is difficult to prove a charge of rape, it is doubly so to disprove it. While we believe that the professional examiner should confine himself in his sworn testimony to what he knows from his own observation, it will do no harm and may be of much service for him to take notes of what is told him as to the circumstances of the assault, by the woman and her friends, since he is generally consulted before sufficient time for elaboration has elapsed. The position assumed in coitus is important; a tall man would experience great difficulty in holding carnal intercourse with a short girl in the upright position. The marks of struggle should correspond in a general way with her story of the assault and the position into which she was forced. The examination of the locality and antecedents of the accuser are legal points of service in elucidating the truth of the charge, but only in exceptional instances has the physician anything to do with them. In case the woman was dragged through underbrush, he might be required to say whether, in his opinion, the marks on her person could have been produced in such a way.

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[1] Gaz. des Tribunaux, 1884. [2] Ann. d'Hyg., vol. xxv., pp. 83–88, 1891.

Error in Examinations.—The trouble lies often at the door of the physician who, in giving a certificate, makes false representations through ignorance. If he is not circumspect, the lies of the woman may unconsciously lead him to make a report favorable to her accusation. In the case of children, of which we shall have more to say later on, the mother's state of anxiety, added to the child's misstatements, are the first causes of error. Brouardel's[1] rules for the guidance of the examiner are worthy of reproduction:

(1) He must close his ears and open his eyes before forming an opinion, and he should swear only to what he himself knows. (2) He should not content himself with a single examination. (3) He should not give a certificate until he has acquired actual experience. We have given these in substance before, but they cannot be too clearly put.

Of the examination, little remains to be said. One other condition of the hymen may be a source of error. In the form in which a central bridle separates two lateral openings, this tongue may partially disappear, leaving only a floating fragment, liable to be mistaken for a tear. A finger or an instrument should always be passed behind the membrane to erase its folds and bring to light any tears or cicatrices. Especially, where there is inflammation, excoriation, or a discharge, a second visit is of paramount importance. The diagnosis is always extremely difficult and often impossible, even with every scientific aid at command, so that an unguarded expression of opinion is dangerous in the extreme. Follow the course of the malady. Time, and time alone, will often clear up the question of differentiation.

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[1] "Cause d'Erreur et Règles d'Expertise dans le Affaires d'Attentat à la Pudeur," Gaz. de Gynécol., vol. iii., pp. 49, 65.

THE AUTHOR OF THE ATTEMPT AT RAPE.

A thorough examination is usually required of the accused in a trial for rape, since it may furnish corroborative testimony of the charge, and in the absence of any signs it may be negative evidence of its falsity. The responsibility or lack of it from mental or nervous disease in the defendant may be part of his defence. (Its consideration will be found in the chapter on Insanity.) It may be remarked, in passing, that Kraft-Ebing and Lombroso are both of the opinion that the majority of those who commit the crime are degenerate, particularly when it is perpetrated on children or old women.[1]

The physical powers of the accused, particularly compared with those of his accuser, should be considered. If it is a question of a boy under the age of puberty or of a man far advanced in years (men past sixty have been put on trial), or of a man whose sexual capacity is impaired by any cause, the physician will be called upon to decide as to his potency.

The physical examination should be thorough. Beginning with his clothing; any tears or loss of any portion of it, buttons particularly, which are afterward discovered at the scene of the assault, may be silent witnesses of a struggle. The character of the earth on the man's boots or clothes may be found to correspond with that of the ground designated. Stains of paint, tar, oil, in one case fibres of red woollen underwear caught in the pubic hair, have served as additional means of identification. Spots of blood, semen, and venereal discharge should be carefully cut out and preserved for microscopic examination. In the event that the clothes are filthy, as often happens, nothing definite can be learned from their appearances, and the only reliance is the examination of the person of the accused.

If the woman was in condition to defend herself, being in full possession of her faculties, such marks of struggle as scratches, bruises, and laceration will be found on exposed parts, the face, hands, and region of the genitals. The frænum may be ruptured by the violence employed, which may cause the only hemorrhage present, an event which happened in one instance. Further, the female may suffer considerable loss of blood and not a stain be discoverable on the ravisher, though no opportunity for cleansing himself has been permitted him.[1] Any clotted hairs should be cut off and preserved with the stained clothing.

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[1] "Psychopathia Sexualis," p. 397.

The penis deserves a full share of attention (see case, p. 429). The importance of the presence of venereal disease in either or both of the parties has been dwelt upon. The existence of smegma around the corona glandis should be noted, but the discovery of semen in the urethra is of little or no moment, unless the examination is made within a few hours after the crime. The first stream of water passing through the canal will wash out every trace of it.

The locality of the assault sometimes receives a share of attention, and the medical expert will be perhaps called upon to determine the nature of spots of semen, blood, etc., found there, as well as to establish the identity of its soil with the dirt found upon the person or clothes of the accused and the accuser.

A few words will not be out of place as to the lines of defence usually adopted in trials for rape. The first and, of course, the most important, since it completely establishes the innocence of the accused, is an *alibi*. Hence, great stress is laid upon the duty of the medical examiner to note the exact day and hour of the alleged assault. The proof of an *alibi*, we may add, does not weaken in any wise the strength of his testimony as to penetration of the female genitals. *Impotency* is frequently advanced as showing the inability of the man to have committed the crime. Its existence in the true form in such a degree as to preclude erection is very rare, except in certain organic diseases such as diabetes, locomotor ataxia in its later stages, various paralyses, etc., in the physiological impotency of extreme youth and old age; in the class of cases known as false, "there is often no impotency at all, except in the mind of the individual."[2] *Disproportion in the size of the organs*, if the rape is committed on a child, is no defence as the crime is now defined in law. It may be argued that the locality was such, in a tenement for instance, that cries or the sounds of struggle would have been heard by neighbors. Simulation of pudendal and other injuries either by the woman herself or by some other person, particularly where children are concerned, may supply the basis of argument for refutation of the charge.

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[1] Taylor: "Med. Juris.," 2d Lond. ed., 1873, vol. ii., p. 444.

[2] Keyes: "Gen.-Urin. Dis. with Syph.," p. 431.

EVIDENCE OF RAPE AFTER DEATH.

Medical testimony may be required as to the nature of injuries found upon a cadaver, whether rape was committed and, if so, whether it occurred before death, whether the injuries were sufficient to cause death, and, in case they were, whether they were inflicted by the act of rape or by other violence.

A superficial examination of the surface of the body is by no means sufficient; a most thorough and painstaking autopsy is the only thing admissible in such circumstances. The buccal cavity and vagina should be examined, the former in order to note the introduction of foreign bodies, for the purpose of preventing outcry on the part of the woman. The vagina and pubic hair may be found to show spermatozoa, but, in the absence of any statement on the woman's part, this indicates merely that sexual intercourse has occurred.

The numerous cases of death, quoted under Accidents, all due to rape, show a different cause for every instance, a sufficient plea for a complete post-mortem. An account of the evidence found at the autopsy table is given in one or two, and in the others the accompanying reference will furnish any additional information required. In these cases, however, death occurred after the crime of rape was discovered. Taylor[1] gives an outline of an alleged murder trial in Edinburgh bearing on the subject. Examination of the body showed stains of semen(?) which, in conjunction with other testimony, established the commission of rape. The man was found guilty of this crime but not of the murder. Another instance of the same purport is related by Casper.[2]

The difficulty will be very great in case of external violence to decide whether the marks were due to rape or to some other cause; in the vast majority of examinations, it will be impossible. In the case of a very young girl, who had not reached the age of consent, the presence of injuries about the genitals point clearly to rape; but in a young woman, the signs of defloration, no matter how pronounced and how recent, how extensive the inflammation and lacerations, can only be accepted as such, for they do not prove that she did not permit the intercourse. When added to these, however, are other marks of violence and a struggle, coupled, perhaps, with a previous character for chastity in the dead, the evidence is circumstantially in favor of the inference of a rape upon her.

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[1] "Med. Juris.," 11th Am. ed., p. 672.

[2] "Klin. Novellen," p. 17.

RAPE UPON CHILDREN AND INFANTS.

This is a far more common crime than that on adults. The chief reason for such a condition of affairs is, of course, that the child, by reason of her innocence and ignorance and comparatively feeble physical powers, falls an easy victim to the ravisher. Another cause is the wide-spread superstition, particularly in Europe, but imported into this country as well, that intercourse with a virgin is a certain cure for venereal disease, a remedy actually suggested by ignorant women who treat such ailments. Syphilis is included in this as well as gonorrhœa, and the balanitis produced by chancroidal and other subpreputial ulcers. A discussion of this point seems uncalled for; an uneducated, superstitious man is not likely to stop for a nice differentiation in the cause of the discharge which he observes on the head of his penis. Vibert and Tardieu have collected the statistics of French courts as to the relative frequency of the crime in the years 1841 to 1880, and 1875, respectively. In spite of the shorter period of time, Tardieu's figures ("Attentats") are much larger. In a total of 22,017 cases before all the courts of France, 17,657 were crimes committed on children. Vibert's[1] table, which we copy in full, is given, as he says, in quinquennial periods, the *mean annual number* for each five years for all France, thus accounting for the difference between them:

	Adults.	Children.
1841–1845....	207	359
1846–1850....	217	431
1851–1855....	234	608
1856–1860....	224	702
1861–1865....	214	766
1866–1870....	153	755
1871–1875....	145	748
1876–1880....	122	809

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[1] "Précis de Médecine Légale," p. 286.

It will be noticed that in the mean number of children for these periods there has been an actual and progressive increase up to the latest date. In the number of adults, however, there was first an increase, then a decline not only relative to the number of children, but actual as compared with the first of the series. This is a curious and interesting condition for which the author offers no explanation.

Violation is the term used by foreign jurists, French, German, Austrian, to cover all varieties of immorality with children under the age of consent, which is usually with them fourteen. In England and the United States, the crime is split up into rape, attempt at rape, and indecent or criminal assaults. The defendant is usually a broken-down debauchee or a very young man who, for some reason, has doubts of his virile powers. The disproportion between the organs, male and female, when the girl is immature, precludes the possibility of intromission otherwise than at the expense of great violence, which is seldom resorted to, and the man usually contents himself with introducing the head of his organ between the labia majora or the thighs of the child. There it is held until ejaculation occurs. The crime is generally the outcome of a perverted sexual instinct, and occasionally coitus is not even attempted. Ejaculation is secured by handling of the girl's genitals, having her expose herself, and then masturbating, or compelling her to perform manustupration. "It is psychologically incomprehensible that an adult of full virility, and mentally sound, should indulge in sexual abuses with children."[1] This may be and probably is an overstatement, but the views of Krafft-Ebing are in the main correct. The occasion for these words of preface will become apparent as we proceed. We shall adopt the same general outline as in the preceding division, merely pointing out the differences and modifications of the adult condition in children where it is possible; if the difference is a wide one, or if the condition is peculiar to girls and children, it will be discussed at length. Our object in this treatment of the subject is to prevent, as far as possible, any repetition.

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[1] Krafft-Ebing: "Psychopathia Sexualis," p. 402. See also same author for further consideration of sexual perversions with children.

THE CONFORMATION OF THE GENITALS.

With the approach of puberty, great changes take place in the female genital organs, externally as well as internally, so that their immature condition is vastly different from that already described. In children, the median slit of the vulva lies in front, so as to be in full view when the girl is in an erect position. The *labia majora* are generally plump, soft, and rounded in a well-nourished child, but may be shrunken, thin, and atrophied in one who is emaciated. They completely cover the labia minora, lying in apposition except anteriorly where they separate, showing the urinary meatus. The *nymphæ* are tiny folds of mucous membrane, entirely hidden in the normal condition of the vulva. The *clitoris* is scarcely more than a tubercle; its prepuce is not movable under ordinary conditions, but prolonged habits of masturbation will cause it to increase considerably in size, and will produce modification of the entire appearance of the vulva. The lips will be separated, the nymphæ reddened and enlarged, the clitoris easily erectile, and the vulval canal having a general funnel-shape. The exception furnished by Brouardel's report of this condition, occurring congenitally in three sisters, has already been twice referred to. (The whole vulval canal is relatively much longer in youth than after puberty.) Atrophy of the lips from leucorrhœa, emaciation, or cachexia will also cause their separation toward the posterior commissure. The fourchette and commissure are important in examination for evidence of rape in children, since, owing to the size of the opening, they are more commonly injured by intercourse than in grown women.

It is due to the deep situation of the hymen and the difficulty experienced in bringing it into view that mistakes as to its presence in childhood are so often made. The thighs should be well separated and the lips of the vulva separated with two fingers. In this way it is more easily shown. The most common form in young children is the one with a central, antero-posterior slit; next, the annular with a large, single opening; next, the crescentic, and last, the diaphragmatic. The opening, even in girls of twelve, is rarely large enough to admit the little finger of the examiner. The membrane itself is generally drawn tight across the vaginal opening, is thin, soft, and elastic. Its border may be clear cut and rounded, or slightly fringed as in the older form. The *vagina* and *introitus vaginæ* are very small and narrow, the latter almost occluded by the hymeneal septum (see Study of 200 Cases, p. 475.)

DEFLORATION.

With young girls, complete defloration is rare because of the difficulty, not to say impossibility, of intromission. Not only the deep situation of the hymen, but the narrowness of the pubic arch and of the soft parts oppose the introduction of so large a body as the male organ in erection and protect the membrane from injury.[1]

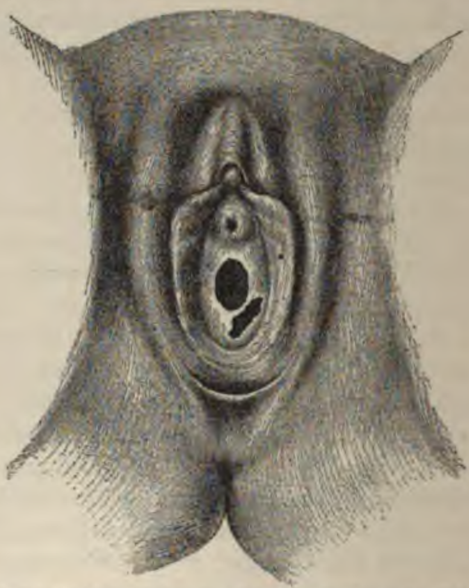

FIG. 73.—Vulva of Child, Showing Button-Hole Laceration of Hymen.

When lacerations are discovered in the hymen, as a rule, there will be in addition more or less extensive injuries in other parts of the genitals (see also our proportion under "Hymen," in Study of 200 Cases). Tardieu, in 118 cases of rape on children of twelve or younger, found hymeneal tears eleven times in children of eleven, once in a girl aged nine, once at six. Vibert,[1] in 186 cases, found the condition in two only, aged nine and eleven respectively. In a total of 106, according to Tourette,[2] the hymen was intact in 82, torn in 14, incompletely ruptured in 9. The shapes of the lacerations are, roughly speaking, the same as those which occur in the defloration of the adult, with this exception: Protected as it is by its situation, it often happens that the membrane is just reached by the tip of the glans penis, and, being elastic, gives before it. If the pressure becomes great, the limit of elasticity is reached at last and a tear is made, a slit like a buttonhole, the result which would happen under like conditions elsewhere (Fig. 73). By far the most common hymeneal laceration in children is the stellate, and the rupture is generally complete to the base of attachment. In the form with a central slit the tear is generally double, one on either side running toward the lateral attachments. Where the laceration is single, it may be median, generally in the crescentic

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[1] Fredet: Annales d'Hygiène, 1880, pp. 248–251.

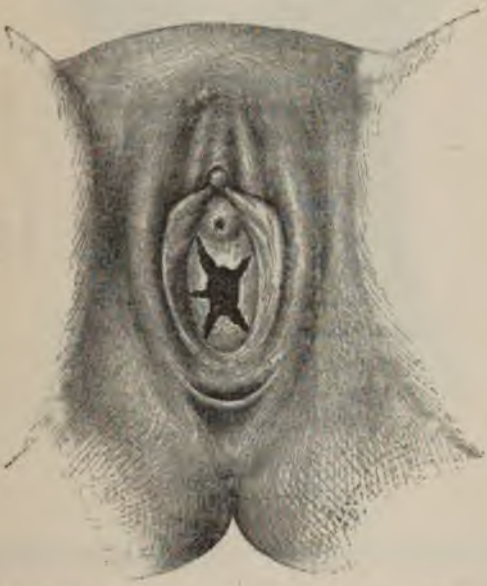

FIG. 74.—Vulva of Child, Showing Stellate Lacerations of Hymen.

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[1] "Nouv. Dict. de Méd. et Chir. Prat.," vol. xxxix., p. 484.

[2] *Ibid.*, vol. iii., series 5, pp. 658, 669.

form, but ordinarily it takes place to one side or other of the median line, the favorite situations being the left antero-lateral and the right postero-lateral (see study of the 200 cases; Figs. 75 and 76). The hymen may be reduced to a mere ring by masturbation or repeated acts of intercourse.

If intromission has been accomplished, the vagina and ostium vaginæ will show some marks, not infrequently serious injuries. The fourchette and posterior commissure suffer as well, and when the violence employed is great, the integrity of the perineum may be destroyed.

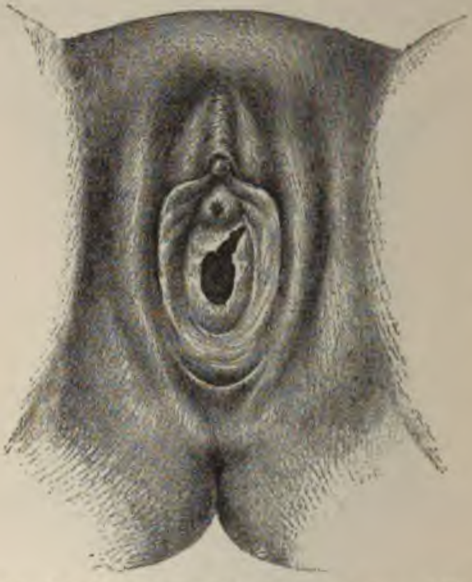

FIG. 75.—Left Antero-Lateral Laceration in Hymen of Child.

Incomplete defloration is the condition usually found. Pain and difficulty in walking are as important symptoms here as in grown women, but they will be present also if the inflammation is artificially produced in support of a false charge. The appearance of the vulva will not differ materially, as to lacerations, hemorrhage, swelling, and other inflammatory symptoms, from that described in adults, but the discharge which is present in so great a proportion of cases, and which figures so largely in trumped-up accusations, deserves more than a passing notice.

Infantile Leucorrhoea.—The presence of a discharge is more often adduced as evidence of rape upon girls than perhaps any other symptom. The mother discovers some day, in the process of her chronic interference with the child's genitals, so common among the lower classes, that her daughter has a discharge. Some one must surely be responsible for it, and she storms, threatens, and torments the little one into accusing an innocent person, a man against whom she may have a grudge.

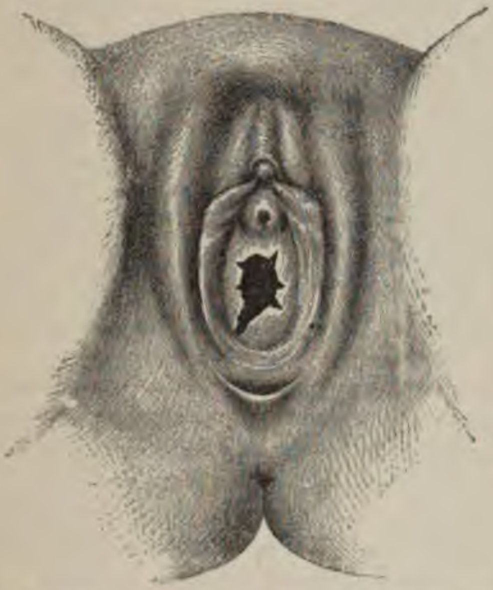

FIG. 76.—Right Postero-Lateral Laceration in Hymen of Child, with Minute, Marginal Tears.

By dint of persistent questioning and suggestion, between them, a story is elaborated and the charge brought. This is the substance of Astley Cooper's famous "warning," so often quoted. Leucorrhœa is one of the common affections of childhood, due to a number of causes, particularly frequent up to the age of six or seven years. These discharges are either catarrhal, due to a vulvo-vaginitis or endometritis, or they are gonorrhœal, the proportion of the latter cases increasing steadily with the perfected methods of investigation of later years. They are both liable to be mistaken for the discharge due to violation, and again the examiner is cautioned against a hasty and imperfect diagnosis. The true vaginal or uterine catarrh can be distinguished from the discharge of defloration when an assault has been committed, by the absence of injury to the genitals, by its chronic course; in case the charge is a false one or the injuries are so slight as to leave no trace, only by its duration or history, if this is obtainable. The discharge caused by violence will disappear in a few days, ten at the most. When the discharge is gonorrhœal the presence of gonococci will determine its character, but there is absolutely no method by which it can be differentiated from a similar secretion resulting from the contagion of impure intercourse, unless it can be proved that the condition existed before the assault.

We have referred to the two cases of Capuron[1] in which false charges of rape on children were preferred on the strength of a purulent discharge whose nature was mistaken. Taylor reports three cases of his own in this connection,[2] but "a purulent discharge depending on inflammation of the vagina" may as well be gonorrhœal as catarrhal. The grounds for the author's diagnosis of non-specificity are not apparent. Tidy[3] also cites an instance.

The simple *catarrh* due to vaginitis or endometritis may be caused by general systemic conditions, such as disturbance produced by dentition, the scrofulous diathesis or by local irritative causes, uncleanliness, seat-worms, masturbation. Its clinical characters are likely to confound it with true gonorrhœa. The discharge is yellow and thin, varying from that to greenish, thick and viscid. It dries, forming crusts on the labia. The urethral orifice is swollen and inflamed as well as the hymen, the folds of the vaginal mucous membrane contain pus, and in the cervix uteri a drop is often visible. The labial and vaginal mucous membranes may be the seat of superficial ulceration. Under the microscope, however, the solid portion of discharge is seen to be composed of vaginal epithelium, leucocytes and multitudes of bacteria in rods, single cocci and diplococci, which may exist in the leucocytes or upon the epithelial cells, distinguishable from gonococci by the methods explained (see Stains, Rape on

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[1] "Méd. Lég. des Accouchements," p. 41.

[2] "Med. Juris.," 11th Am. ed., p. 654.

[3] "Legal Medicine," American edition, vol. iii., p. 149.

Adults, p. 438) even when a leucocyte contains only diplococci. Treatment has no more effect in shortening the course than in gonorrhœa, but it may diminish the amount of discharge. The secretion is sometimes, though it is non-specific, infectious.

True gonorrhœa in young children has been described by Pott, von Dusch, Spaeth, and Steinschneider, and not long since Epstein[1] found gonorrhœa in new-born female infants. Cahen-Brach[2] collected thirty cases, and Koplik[3] has published seventeen within the last year, in all of which the microscope made the diagnosis. It is often more than difficult to discover the origin of the infection, which may become so widespread (Fraenkel) as to create an epidemic. The modes of contagion are generally mediate from adults suffering from the disease, particularly in city tenements where the herding is appalling, father, mother, and children sleeping in one bed. Under such conditions, the only cause for astonishment is that all the children, male and female, do not suffer from gonorrhœa when it has once made its entrance. The use in common of sponges, towels, even the seats of closets may serve to spread the contagion. After all, the origin is not of great importance, if the existence of the discharge previous to the date of an assault is proved.

The discharge is thick, ropy, yellow, drying in greenish-yellow crusts on the labia. Urination is painful. There may be vulval erosions, and, as in the adult, the vagina is intensely inflamed and is the seat of granulations which bleed easily. The urethral orifice and the hymen are red and bathed in pus. The cervix uteri is practically always involved. The course is slow beyond expression, and the disease very rebellious to treatment. It will be noticed that this picture differs little from that of violent catarrhal inflammation, and the stages of subsidence resemble each other as closely. When the gonococci are found and fill all the conditions of identification, the diagnosis is made.

It should be remembered, in this connection, that syphilis may pass from one person to another by mediate contagion; and further, the fact must never be lost sight of, in crimes of this kind on children, that girls are frequently ardent solicitors of immoral practices on the part of boys. The peculiar funnel-shaped vulval cavity is evidence in favor of such repeated acts. The case of Reg. *v.* Golding and Neal (C. C.C., March, 1891) illustrates this point. The two defendants, each aged sixteen, were accused of rape upon a girl of fourteen. Connection was effected by one boy holding the girl while the other practised coitus with her; in both acts, all parties were standing. The intercourse was not denied, the defence being that the girl consented. Medical examination, after six days had elapsed, showed an inflamed and dilated vagina and a ruptured hymen. Conviction was secured on the charge of carnal knowledge of a female under the age of consent. If she had so desired, the girl might easily have prevented connection by merely stooping, an act which could not have been prevented by the boy holding her arms.[1]

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[1] Archiv f. Dermatol. und Syph., Bd. 23, 1891.

[2] Jahrbuch f. Kinderheilk., Bd. xxxiv., Hft. 4.

[3] Journal of Cutaneous and Genito-Urinary Diseases, vol. xi., Nos. 129 and 130, 1893.

Wilde[2] has gathered together quite a number of cases of false charges of rape on children, two of which deal with the question of the presence of a discharge forming the basis of the accusation. In one of these, the charge, uncorroborated by other evidence, marks of violence, etc., was strengthened by the testimony of one medical witness who declared that the condition of the child's parts might have been the result of violence, and that the discharge might have been caused by friction with the penis. The accused was suffering neither from gonorrhœa nor syphilis. Other witnesses affirmed that the girl was probably suffering from a common disease, and that there were no marks or other evidence on which to base a charge of rape. In view of the element of doubt (the court did not consider that the charge was completely answered) the man would certainly have been convicted on the child's statement alone, had he not proved an *alibi*. In summarizing these remarks on the subject of discharges in children, it may be said that their presence is testimony admissible in corroboration only when it is conclusively proved that the child had not, prior to the alleged assault, suffered from such a disease. This applies in all cases, but when gonorrhœa is found, there must be some evidence of it in the defendant, and its period of incubation in the child must have been of sufficient length (see consideration of same subject in Rape on Adult Women).

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[1] See paragraph on diagnosis of examiner, Study of 200 Cases, p. 481.

[2] "Medico-Legal Observations," etc., 1853.

POSSIBILITY OF INTROMISSION.

The age when this occurs is variously stated by different authors. Tardieu holds that it may be as early as ten, while Toulmouche places it at fifteen, and between these figures, by others at any age. It is a question of the age of puberty, of course, and this varies so widely within the limits of a single country even (our own, for example) as to make the discussion quite profitless. If possible at all at the age of ten years, intromission for the adult organ can only be incomplete, the common result of rape perpetrated on young children. This is shown nowhere better than in the deplorable results of Indian child-marriages, where girls of this age are lacerated in shocking manner by efforts at coitus on the part of their husbands. Dr. Harvey has given a graphic picture of this condition of affairs.[1] Intromission is often possible for an undeveloped youth, when an adult makes an entrance into the vagina at the expense of lacerations of the perineum.

VIOLENCE.

Marks of violence, outside of the pudendum, are not common in children under the age of twelve, because resistance, if made, is usually slight. In very young children, it is a rarity to find any bodily evidence of a struggle. This fact will be clearly brought out in the consideration of our cases. In such a case, combined with an absence of injury to the pudendum, the medical jurist has no interest, except so far as he may be called upon to answer hypothetical questions as to the possibility of an assault having been made. He should be careful not to commit himself in saying that a rape could not have been perpetrated. Rape, in its strict legal sense, may have been committed not only without leaving a trace at the time, but the marks of violence disappear often with remarkable celerity. Toulmouche,[2] has discussed the subject of the absence of physical evidence at length. Casper is the authority most frequently quoted as to the evanescence of signs of rape in young children. One case, with the weight of his personal experience, deserves particular mention. A girl of eight was raped by a drunken man who was caught in the act and confessed his crime. The next day, medical examination showed only slight redness of the labia and os vaginæ, with some sensitiveness of the vagina itself. After eleven days had elapsed, Casper examined her and not a trace of any kind was to be found. We shall have something to say regarding the misleading statements of the child or her parents and their effect on the examiner, in speaking of false accusations.

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[1] Indian Med. Jour., 1875, p. 284.

[2] Ann. d'Hyg., 1864, t. 2, p. 338.

When a rape has actually been committed, however, by an adult on a young child, the injuries to the pudendum by the mere effort at intromission are not seldom great. The male organ[1] may, without doubt, produce extensive laceration, whether resistance is offered by the girl or not, but in a certain number of cases the hands are used in enlarging the vulval entrance. A trial for rape was held in the Court d'Assizes de Vaucluse, France (1886) in which the accused confessed that he had first made the tear, then committed the assault. The girl, aged eight, died not from her injuries, but from suffocation produced by the man, although examination of the body showed perforation of the recto-vaginal cul-de-sac and almost complete perineal laceration. Our own case, of a baby raped by her father, already referred to, may fall into the same category. It has already been established that such violence, from its immediate effects, may prove fatal (see Defloration and Marks of Violence in Adults).

We shall select, from the number reported,[2] but one additional case, a murder trial at Chelmsford, England, in 1874, which presents some peculiar features. A youth confessed a rape upon a girl attended with such violence as to cause her death. The rectum and part of the intestines were forced out in the act of coition, which, according to the story of the prisoner, took place after death.

Nothing more need be said regarding death from such accidents as septic poisoning following rape, or the simulation of the effects of violation by *noma pudendi* and the founding of false charges upon mistakes as to its nature.

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[1] Vierteljahrssch. f. gericht. Med., 1863, p. 337.

[2] "Med. Juris. for India," p. 468; Med. Times and Gazette, 1860, i., p. 560, etc.

When the girl has reached maturer years, has passed the age of thirteen, she is considered to have some idea of the meaning of the assault, and to be capable of offering some resistance. Marks of violence are then more often found beyond the region of the genitals in true accusations of rape. The law, in England and in some of our States, recognizes this fact of partial responsibility by making carnal knowledge of a female between the ages of thirteen and sixteen, with her consent, a misdemeanor only The hymen would probably be ruptured at this age, but would escape injury, in case it were small or deeply situated. Even then, if a boy were the ravisher, it would be injured. (*Vide* Liverpool Winter Assizes, 1862. Rape of three children by a boy, aged seventeen).

FALSE ACCUSATIONS OF RAPE ON CHILDREN.

False charges may arise from two sources: from inadvertence[1] due to the anxiety of the mother as to a vulvitis or discharge discovered in her child, the class against which Astley Cooper's warning (*vide supra*) is primarily directed, or from malice aforethought,[2] in an endeavor to fix the crime upon an innocent man. In either case, the medical examiner must be upon the lookout to avoid being influenced in his report by the statement of interested parties. Proofs of rape have been described upon a girl's genitals weeks after the date of the alleged assault, when such a statement is incredible, and when, doubtless, if the child had been brought to the physician to be treated for a discharge, he would have ridiculed the idea of its being due to an assault.

Much sentiment has been wasted on the frankness of childhood. There is little, if anything, more false. In a charge of this kind she finds herself a centre of attention; it naturally increases her importance and makes of her a heroine in her own eyes. Either she has learned her lesson by dint of her mother's inquiries, repeated time and again, or she has been taught, supposing the lie a deliberate one, until she can repeat it word for word. According to Fournier (*op. cit.*), this is a point worthy of notice. Suspicion should be aroused when the child tells her story as though gotten by rote, with the same words, the same inflections, the same mistakes even. If interrupted, she is confused and is perhaps obliged to go back and begin again. This examination should always be conducted away from the parent's prompting, and Fournier states that, under such circumstances, he has succeeded in bribing the child into telling the truth.

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[1] Brouardel: "Les Causes d'Erreur," etc., Ann. d'Hyg., vol. x., pp. 60, 148.

[2] Fournier: "Simulation d'Attentats Vénériens sur les Jeunes Enfants," Ann. d'Hyg., vol. iv., p. 498.

When the accusation is designedly false, examination generally shows an intensely inflamed vulva, attended by difficulty of movement and pain on micturition, the result of the maladroitness of the simulator. Its very intensity is evidence against its genuineness, but there is not a single differential sign to distinguish between the two. On October 26th, 1880, Professor Fournier presented before the Paris Academy of Medicine a child, aged eight, said to be the victim of an assault. The vulva was violently inflamed, the labia swollen and eroded. All the parts were very red and tender, and covered with thick, greenish pus. The hymen was intact and the inguinal glands on either side were swollen. She was cured in two weeks. She confessed, after a time, that the condition was caused by friction with a blacking-brush. The discharge might, of course, have been distinguished from gonorrhœa, but there was nothing to aid in separating it from the discharge produced by defloration. Its intensity, alone, awoke suspicion.

We cannot agree with the eminent writer quoted in saying that it is part of the doctor's duty to acquaint himself with the child's surroundings and associates in order to determine if possible the motives for the charge. This is the field of the detective, not the physician. False charges of this kind are inspired by greed or a desire for vengeance. Of these, the first is the more common, merely a variety of blackmail, which Tardieu calls "chantage au viol." Money is extorted by a threat of rape. A wealthy man is selected; it is arranged to leave him alone with the child for a time; a vulvitis is started by means of irritants, and the victim threatened with exposure. The plan is much the same when vengeance for some real or fancied wrong is the motive. The girl herself, in spite of her youth, may bring a false accusation of her volition, as in the case of Alphonsine M., fourteen years of age (see False Accusations in Adults). Had it not been for her bad character and dissolute habits, the man would probably have been convicted.

Public sympathy aids even more in the prosecution of rape trial where children are concerned than where the charge is brought by an adult. The crime seems to arouse a horror in the public mind only satisfied by the sacrifice of some victim. If the physician, after making his examination, writes out his report without consulting his feelings, with as strict impartiality as the presiding judge in the trial, weighing all the considerations of the question in his mind, and, above all, testifying only to what he himself knows from what he has seen, the great disproportion between the true and the false in accusations of rape will be a thing of the past.

We have one more caution to add to the long list, and that is that the certificate be delivered to none but recognized authority.

A CRITICAL STUDY OF 200 CASES OF RAPE ON CHILDREN IN THE CITY OF NEW YORK.

General Considerations.

The tabulated statement of these cases was compiled from the reports of the examining physicians of the Society for the Prevention of Cruelty to Children, of New York City, extending over a number of years, as far back as 1884–85. Of these, 176 have fallen under our own observation and 24 were taken from the published reports of Walker's[1] observations. The history of each was arranged in a series of parallel columns, showing the age, marks of struggle, and other notes of interest side by side, with the history of Case No. 2 placed just below that of Case No. 1, following each other in regular order, in this way facilitating comparison. When it happens that the number of times a given symptom occurs, does not correspond with the total, this discrepancy is due to the fact that it was not noted in the missing number of cases.

The average **age** was something more than twelve years, the exact figures in 120 instances, in which the mean was taken, being twelve years four months and sixteen days, allowing thirty days to the month. The oldest was a young woman of eighteen and the youngest an infant of eight months.

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[1] "Reports, with Comments, of Twenty-one Cases of Indecent Assault and Rape upon Children." Walkea: Archives of Pediatrics, vol. iii., nos. 5 and 6. Some of his "cases" include more than one assault.

The **birthplace** of the children, which is given 164 times, is not of great importance, except as showing the polyglot nature of the tenement population of New York from which almost all these cases came, and from the rather curious fact that penetration seems possible as early in girls born in this country as in those from the southern countries of Europe. In the presence of the multitude of Irish and Russian Jews in the East-Side population, their small representation is remarkable. The United States naturally heads the list with 106; Italy follows, after a wide gap, with 19; then Germany with 18; Poland with 4; England, Ireland, and Austria with 3 each; Russia and Scotland with 2, and Hungary and Switzerland with one apiece. Only three of the number belonged to the negro race.

The **occupation** of these children was stated in 92 of the records. The majority of them probably were either too young for school or for work, and were kept at home. Forty, however, were attending some city school; 24 were domestics or kept house in their own homes; 20 were apprenticed to various trades, such as silk-weaving and millinery, and 8 claimed a profession—saleswomen, danseuse, bookkeepers, etc.

INTERVAL BETWEEN ASSAULT AND EXAMINATION.

The average interval which elapsed between the date given for the alleged assault and the examination by the Society's physician, in 56 cases, was 9.2 days, apparently a considerable space of time and, from what we have said, quite sufficient for the disappearance of the signs of rape. On the other hand, it must be remembered that the majority of these charges, as in statistics of rape cases generally, are false and the examination purposely postponed. Moreover, the people were often ignorant and neglected to prefer the charge; and lastly, the figure is hardly a fair one, since when the interval is three months or longer, it vitiates the result to a considerable extent, even in a small number of records. The interval varied between wide limits. In as many as ten it was less than twenty-four hours, the examination taking place on the date of the assault, and in not a few it lengthened out into weeks, months, three to six, and in two or three instances to a year or more.

MARKS OF A STRUGGLE.

One of the most striking observations made in running over these cases was that marks of violence were found in nine cases only. While the entry is not found in every record, it is a fair assumption that if such had been present they would certainly have been noted. As a matter of fact, their absence is particularly specified in more than half. Allowing for the possibility of their having been overlooked, this number is only five per cent of the total.

The marks of struggle consisted of the usual contusions and abrasions, attended in one case by considerable bleeding, occurring almost invariably in the neighborhood of the genitals, the pudendum and thighs. Bruises were found on the shoulder and arm of one child, with whom coitus had been practised against a tree. She walked also with considerable lameness. The evidences of violence were usually very slight, rather the result of accident or roughness in forcing the thighs apart than from a violent effort to overcome resistance on the girl's part. After what has been said regarding age and its consideration with regard to the child's ability to defend herself, a word as to that will not be amiss here. The ages of the nine children ran from seven to fifteen and one-half years, five of them being more than twelve. No extra-genital marks of any kind were found in girls of sixteen, seventeen, or eighteen (there was only one who reached the last figure).

Vulva.—Of a total of 124 cases, the appearance of the vulva was in every respect normal in 62. In the other half, some pathological change was noted. Fifty-four showed symptoms of inflammation varying in intensity from a mere sensitiveness to a swollen and painful condition sufficient to cause lameness in walking. In 3, there was a distinctly vulval discharge; in 2, there were numerous venereal warts; 2 showed spots of ecchymosis on the inner surface of the labia majora, the labia minora, and fossa navicularis; in a single case was there an ulceration noted, and this was a chancroid seated at the base of the hymen. In 5 cases showing a funnel-shaped vulval canal with a separation of the greater lips, we have thought it worth while to point out the other conditions present with a view of ascertaining whether the condition were found without evidence of penetration. The diagnosis in 3 was penetration of long standing, in one of recent date, and in the other, "inflammation of the genitals due to some unknown cause." Three of the girls were fifteen years of age, 1 thirteen, and 1 eight. The case of the youngest girl was that in which the inflammation was present; her youth probably prevented more than vulval penetration, but the hymen presented an "inverted," inflamed appearance, denoting possibly interference of some kind, *e.g.*, masturbation. Cases 26, 22, and 197 showed rupture of both fourchette and hymen.

The external genitals were found developed at five years of age, but for girls born in this country the average age was fifteen. Complete vulval and vaginal penetration occurred in two American children, and in one child, born in Germany and shortly after brought to the United States, at ten. Complete penetration was found in a single instance in a child, aged seven, American parentage. The hymen was inflamed and the ostium vaginæ admitted the little finger of the examiner.

Fourchette.—This structure suffers much more commonly in rape on children, together with the posterior commissure, than when the crime is committed on adults, for reasons which we have already explained, but even here it is far from a common accident. In 102 observations, it was intact in 86, more than 80 per cent of the whole. When it was injured, it was completely ruptured in 9 cases, showed more or less extensive abrasions in 4, and shared in a general vulval inflammation in 2. It had the appearance of having been stretched in 2 and once was marked absent. It is held that the fourchette is never ruptured except in connection with other injuries in children who have not reached the age of puberty, and in support of that view we shall review briefly the nine cases in which it occurred:

Case 6.—A girl, æt. 12, had evident traces of a previous penetration in the shape of old cicatrices of the hymen and posterior vaginal wall. *Case* 11.—A girl of 11, with a ruptured hymen in addition to the tear of the fourchette. Penetration was not complete in this case, because of the extreme narrowness of the pubic arch. *Case* 20.—The vagina in this child, aged 10, admitted the index finger and the hymen was ruptured. The diagnosis was complete penetration. *Case* 26.—

The hymen was in fragments and the vagina described as roomy. The child's age was 12. *Case* 32.—In this girl, æt. 14, the hymen was torn and the vagina admitted a little finger. *Case* 121.—A baby of eight months whose vagina, hymen, and perineum suffered extensive laceration in the attempt at intercourse. *Case* 140.—This is the only case (8 years of age) in which the hymen was found intact. The os vaginæ was somewhat patulous and the penetration only partial. *Case* 149.—The age of this girl was also 8. Her vulva showed recent tears and abrasions and the hymen was ruptured. The vagina admitted a finger. *Case* 197.—There was complete penetration in this girl, æt. 15. Her vagina and introitus were dilated and her hymen was torn. The case may rest on this evidence.

Hymen.—The appearance of the hymeneal septum was noted in a total of 182 cases, 24 of which are Walker's and 158 are part of our own reports. As we have had occasion too mention in speaking of the frequency of the presence of the membrane, we have never found it absent. Of our own cases, 35 showed no evidence of injury; tears were present in 106, of which 87 were ruptured more or less completely and 19 were slightly lacerated. Fifteen times, the opening showed evidence of having been stretched or dilated; in 8 cases it was inflamed, and in 5 the appearance was of a previous laceration, cicatrices and fibrous-tissue formation being noted.

The shape of the membrane was, unfortunately, noticed in 14 instances only. The annular form occurred more often than all the others together—10 times; next came the crescentic, 3; the imperforate, 1. The shape of the tear was mentioned in 14 instances; it was described as stellate in 7, double in 1, postero-median in 2, left antero-lateral in 3, and right postero-lateral in 1 (See Figs. 74, 75, etc.). The buttonhole laceration was once described (Fig. 73).

Sixty-nine observations were made in children under twelve years of age, when defloration is claimed to be a rarity. Including unsubstantiated charges, 43 were found on examination to have an intact hymen. It was ruptured in 21 cases, nearly one-third, and dilated in 5, figures which hardly lend color to the assertion. When the hymeneal tear occurred in children of eight years or younger, other injuries were always present, but the possibility of manual violence previous to connection with girls of such extreme youth should always be borne in mind. The hymen was ruptured in common with other lacerations of the parts in 13 cases. Those in which the fourchette suffered injury, 8 in all, will be found in the last paragraph; the vagina was twice lacerated, and the integrity of both these structures with the hymen was destroyed four times. Of these latter, one was the baby in which the laceration of the perineum extended into the rectum.

Vagina and Ostium Vaginæ.—We have some doubt in our own minds as to whether the figures in this connection will be of any particular service, owing to the wide range of age and the impossibility of anything like accurate measurements. They are given, however, for what they are worth. The vagina, in a total of 80 observations, was found normal in all particulars in 27; it showed inflammatory symptoms in 25, was lacerated in 6, and had the appearance of having been dilated in 22. This is one of the points where inaccuracies creep in. The condition was variously described as admitting one finger, "distensible," "roomy," with laxity of the walls, etc.

The ostium vaginæ was entered merely as admitting one or more fingers, not of any great value in view of the different sizes of examining fingers, and of the introitus in individuals and in the same person at various stages of development. In 112 examinations, the ostium vaginæ admitted the index finger in 71, the little finger in 15, two fingers in 11, and permitted the passage of neither in 15. In these cases, 5 girls confessed to habits of masturbation, and 8 admitted the previous practice of sexual intercourse, in one of whom it had continued for some little time, although she was only twelve years of age. The record does not so state it, but the presumption is in favor of the act having been committed with boys.

Secretions.—All forms of discharge were included under this heading, leucorrhœal, gonorrhœal, and that resulting from attempt at intercourse. Microscopical examinations were seldom made, but gonococci were found in 3 cases of muco-purulent, and 1 of purulent discharge. The total in which observations were recorded was 112. The secretions were normal in amount and character in 41—that is, they consisted of a slight amount of mucus. Those described as leucorrhœal or mucous are very numerous, 38 in all. The muco-purulent, probably most of them leucorrhœal also, were 16; the purulent, in which gonococci were found on examination three times, were 13. Three of the girls were menstruating, and in one the discharge was muco-sanguinolent. The accused was examined in the purulent and muco-purulent cases, and clinical evidences of gonorrhœa was discovered in eight. In one or two, the microscope confirmed the diagnosis.

DIAGNOSIS OF THE EXAMINER.

This is almost always given in one of two forms, and is sworn to in that way, in court. The formulæ are as follows: "There is no evidence present of a penetration of the genitals," or "There is evidence of a recent (or old) penetration of the genitals *by some blunt instrument.*" That is all. The lay evidence must decide as to whether the blunt instrument in question was the penis of the accused.

We see no necessity, no call for the clause which Tardieu gives in his form for medical testimony. He adds to the penetration by a blunt instrument the phrase, "like the male organ in erection." Occasionally, the depth of the penetration, vulval, hymeneal, or vaginal, is given, when the evidence is sufficient to warrant such a statement. If the ratio of false charges to true is, as Professor Amos claims, twelve to one, it is either not apparent in this series, or simulation of the state of defloration is more common than is generally supposed, for in 108 cases a certificate of complete penetration was given (see ages under General Considerations and Marks of Struggle, Study of 200 Cases). In a few cases, with symptoms of vulval inflammation alone, the testimony given was to the effect that there was "acute inflammation of the external genitals due to some unknown cause," or "due to friction with some blunt instrument."

CHARGE AGAINST THE ACCUSED.

These cases have not all come to trial as yet, this being the case especially with those of recent date, but the complete court record was obtainable from the files of the Society in 80. The charge was rape alone in 36, rape and abduction in 4, abduction alone in 16, incest or, as it generally entered, rape by father in 9, attempt at rape in 6, and indecent assault in 7.

The **Plea** in the trial for rape was guilty in 8 instances, not guilty in 14. Of the latter, the jury found a **Verdict** of guilty in 8 and not guilty in 1. Eleven prisoners were discharged for lack of sufficient evidence to convict. The pleas were equally divided in the four charges of rape and abduction; of those who pleaded not guilty, 1 was convicted and 1 released. Twelve men accused of abduction put in a plea of guilty; 4 declared their innocence but were judged guilty of the crime. Four of these cases were dismissed and 1 was settled by the marriage of the parties in court. In the trials of fathers for rape on their children, 4 defendants were discharged, 1 was found not guilty, 1 guilty, and 3 made that plea. In attempts at rape, there were four pleas of each kind, 2 discharges and 2 verdicts of not guilty. In the cases of indecent assault, 2 of the accused were discharged, 3 made pleas of guilty and 1 of the reverse which was confirmed by the jury's finding.

Summing up the total of all the trials, there were 23 pleas of guilty, 27 of not guilty, 23 received their discharge, and 14 were convicted of the charge. Some of the cases have been appealed, and in others the prisoners availed themselves of the privilege of pleading guilty to a lesser crime in order to escape punishment for the greater; as in rape, several entered a plea of guilty to attempt or to abduction.

Verdict.—A total of 44 convictions present the points of interest which we have tabulated, in order that the eye may take them in at a glance.

CRIME.	SENTENCES.			
	Number.	Longest.	Shortest.	Average.
Rape	17	19 years and 10 months.	4 years and 6 months.	10 years +.
Abduction	17	5 years and $1,000 fine (3 cases).	3 days in jail and $500 fine.	3 years and 7 months.
Incest..........	3	18 years and 3 months.	5 years.	13 years and 5 months.
Assault	4	4 years.	6 months.	1 year and 9 months.
Attempt at Rape	3	6 years.	3 months.	2 years and 3 months.

RAPE BY BOYS AND WOMEN.

We have had occasion in treating of rape in other connections to refer to cases in which the ravisher was a boy, one in particular in which intercourse was effected by two youths with a young girl in the erect position. The cases may be multiplied practically to any extent from the literature of law and medicine, but there would be no object in so doing beyond showing at what age connection in children is possible, a point of minor interest after all. Erections are possible at four years of age, and boys have been used sexually at any period afterward (see Krafft-Ebing: "Psychopathia Sexualis"). Manifestation of the sexual instinct may occur in very young children, notably in those with an hereditary neurotic taint.[1] Masturbation has been observed by various writers at the age of four or even three (Maudsley, Hirschsprung, Lombroso, Moreau) in both boys and girls, and the impulses thus awakened may find gratification before the passage of many years in intercourse with a member of the opposite sex. Koplik[2] gives a case in which two boys, aged five and nine, not abnormally developed, acquired gonorrhœa by intercourse with a girl of seven. The consideration of this subject will be confined to its legal aspects.[3]

LAW OF RAPE BY BOYS.

Under the age of seven, the law both in this country and in England holds that a boy cannot commit a felony. Between this age and fourteen, opinions are divided, as will be seen further on; beyond fourteen, he is regarded as an adult capable of judging between right and wrong and therefore morally and legally responsible for his acts. It is in the doubtful age (seven to fourteen) that the youngest ravishers are found, and it is there that the law of England and the vast majority of the United States differs so widely. In 1650, Lord Hale gave his opinion[4] that, under the age of fourteen, a boy must be presumed unable physically to commit a rape, and, although malice is conceived to supply age in other crimes, the law here supposes him innocent. Hale's dictum has been followed without exception in the English cases. In Rex *v.* Eldershaw[1] it was held that a boy under fourteen could not commit a rape, although he might be indicted as principal in the second degree. In Rex *v.* Groombridge, 1836,[2] in conformity with the preceding decisions, the defendent not being of responsible age, was discharged. In Reg. *v.* Phillips, the presiding judge, J. Patterson, gave it as his opinion that no evidence was admissible to show that the prisoner had reached the age of puberty and consequently was physically capable of committing a rape.[3] In Reg. *v.* Jordan[4] the same decision was made, that a boy cannot be convicted of carnally knowing a girl under the age of ten, even if puberty is proven. In a more recent case, Reg. *v.* Brimlow,[5] some evidence is betrayed of a desire to break from Hale's dictum, for the prisoner was convicted of assault.

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[1] Lombroso: "Archiv di Psichiatria," vol. iv., p. 22.

[2] Journal of Cutaneous and Genito-Urinary Diseases, July, 1893, p. 275.

[3] We wish to acknowledge our indebtedness for much of our material to an excellent paper by Brinton on "Rape by Boys," in the N. Y. Medico-Legal Journal, vol. vi., pp. 182-190, 1888-89.

[4] Hale, P. C., p. 630.

In this country, "this presumption of law is generally held to be changed by climatic conditions."[6] The first case in which a reluctance to follow the rule was shown, was Commonwealth *v.* Green.[7] It was held that while the crime itself might go unpunished, assault with intent to commit rape was punishable with the same penalty as in the case of adults. In Williams *v.* State, a celebrated and often-quoted case,[8] the presumption of incapability was held rebuttable by proof that such person has arrived at puberty. As pointed out in connection with female children, the age of puberty, here as there, is modified by the influence of climate, being sooner reached in warmer countries; by condition (a child brought up in the lap of luxury reaches puberty sooner than one enured to hardship) and by habit, idleness, inertia, and overfeeding, for example, being conducive to its early approach. It was in the case of Hillabiddle *v.* State[9] that climate was first considered as modifying the age of puberty, and liability was placed on the ground of ability to consummate a carnal connection. Since this decision, the presumption of physical incapacity is held by the laws of all the United States, with the exception of North Carolina, Florida, and California, which conform to the English statute, no longer conclusive. This was the ruling of the court in Waggoner *v.* State.[1] The decision of the lower court in the case of State *v.* Young, that physical capacity must be determined by evidence, was confirmed by the supreme court.[2] Williams *v.* State is the only reasonable rule in a country so large as this, extending over so many degrees of latitude and offering such diverse climatic conditions. (For age of procreation, see chapter on Impotence and Sterility.)

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[1] 3 C. and P., p. 396, 1828.

[2] 7 C. and P., p. 582.

[3] 8 C. and P., p. 736, 1839.

[4] 9 C. and P., p. 118, 1839.

[5] 2 Moody C. C., p. 122.

[6] Brinton, *op. cit.*

[7] 2 Pick., p. 380.

[8] 14 Ohio St., p. 222.

[9] 3 Ohio St., p. 52.

RAPE BY WOMEN—RAPE BY FEMALES ON MALES.

This crime, which is not uncommon, is not, so far as we can discover, recognized in English or American statutes, but the penal code of France makes it a crime for a person of either sex to attempt intercourse with the other, with or without violence, when the child is under eleven years of age.

The crime is usually committed by a grown woman on a young boy, for the purpose of gratifying a perverted sexual instinct, or in nymphomania when any male may be seized upon to assuage the consuming desires, or by the ignorant, as in cases of rape by men, to cure some venereal disease. The last is the only possible medical means of establishing the fact of intercourse, and even here it would be difficult to prove that the boy did not commit the act through the promptings of precocious puberty. It is a well-recognized fact in many hospitals that syphilis and gonorrhœa are so conveyed to boys of very tender age. The late Dr. Coleman, of Augusta, Ga., narrated such an instance to the authors. A negro nursemaid excited two children under her care, aged five and seven, by handling their genitals, and when she had secured erection, used them both sexually, for the purpose of curing her discharge, thereby inoculating them with a typical gonorrhœa. In a trial which was held in the French courts,[3] a girl of eighteen enticed two boys, one eleven and the other fourteen, into a field and had intercourse with them by force. There was a double motive for the assault, in a narrow vagina which would not permit connection with an adult, and the presence of syphilis which she was proved to have communicated to her victims. A conviction was secured. In 1845, another young woman of the same age was found guilty by a French tribunal of an indecent assault on a boy under fifteen. Casper has recorded two instances, one of them a mother, of the same kind.[1]

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[1] 5 Lea, Tenn., p. 352.

[2] 3 So. Rep., Louisiana, p. 57.

[3] Annales d'Hygiène, 1847, t. i., p. 463.

Instances in which mental aberration and erotomania led to the commission of rape are quite as numerous as the preceding. We shall select only a few. Schürmeyer[2] makes a report of a case in which a mother practised abuse with her son, aged five and one-half years. A girl of eighteen seduced her brother, aged thirteen, into congress with her and also performed masturbation on him.[3] Legrand[4] mentions a girl of fifteen who seduced her brother into all manner of sexual excesses with her; after two years of these practices, he died and she attempted to murder a relative, showing her complete mental and moral obliquity. In the same article will be found the records of two women who held incestuous intercourse with a young brother and a son; in the latter pregnancy resulted and an abortion was produced. The woman declared herself madly in love with her child.

Tardieu states[5] that these cases of seduction by women occur generally in boys between the ages of five and thirteen, but some have been recorded where the children were under five years. Koplik (*op. cit.*) found a gonorrhœal urethritis in a male child of eighteen months. There was no history of abuse, but it is a fair assumption that there was. Domestics, as in Dr. Coleman's case, are often the responsible parties, seeking the satisfaction denied normal intercourse by a narrow vagina, when cure of a venereal affection is not the result sought.

Friedreich discusses the question as to whether a rape is possible by a grown woman on a man. This resolves itself, as in the same question under opposite conditions, into the point whether the force used is sufficient, as the following case which we quote from Schneider[6] conclusively proves:

> Three young women entered the bed-chamber of a youth (who was, it might be said, mentally deficient), two of them seized him and held

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[1] "Klin. Novellen," 1863, p. 15.

[2] Deutsche Zeitschr. f. Staatsarneikunde, 1864, xxii., p. 204.

[3] Lafarque: Journ. Méd. de Bordeaux, 1874.

[4] Ann. Méd.-Psych., May, 1876.

[5] "Les Attentats," etc., Ann. d'Hyg., vols. viii. and ix.

[6] Tourdes: "Viol et Attentats aux Mœurs," "Nouv. Dict. de Méd. et Chir. Prat.," vol. iii., series 5, pp. 558-699.

him firmly while the third secured an erection and succeeded in effecting connection.

Again as with women, stupefying drinks and other means may be employed to aid in the design. Schneider illustrates the point by an instance in which a rich young man was stupefied by wine, and was made to have intercourse with a girl in order that he might be compelled to marry her. The case became public through her efforts to force the marriage. The same author also records a rape, perpetrated on a idiot.

Rape by Females on Members of their Own Sex.

When this crime occurs with grown women as the parties, it is called Tribadism, Lesbianism, or *Amor Lesbicus*, and under this heading, will be found elsewhere.[1] The crime has, however, disgusting as it may seem, been perpetrated in a small number of cases by women on young children. Tardieu (*op. cit.*) reports four observations of this nature. An enlarged clitoris is usually the instrument of passion, but special contrivances have been employed. One of Tardieu's cases was that of a mother who, by this first-mentioned means, enjoyed sexual congress with her twelve-year-old daughter. This is a depth of depravity too revolting for contemplation and one from which the mind is glad to turn. Fortunately, these last reports are rarely or never made public in this country, but instances of the kind are known to the medical profession.

RAPE ON THE DEAD (NECROPHILIA).

This subject should not be confounded with what has already been said on the subject of Evidence of Rape in the shape of Marks upon a Cadaver (*vid. sup.*); in the latter connection, the rape took place before death, having possibly been the cause of it and left its mark upon the corpse; in necrophilia, sexual perversion impels the ravisher to violate the bodies of females after life has passed away. The crime, in spite of its revolting character, is as ancient as civilization. Maschka[2] has collected a number of excellent historical notes on the subject. This form of sexual gratification became so common among Egyptian embalmers in the days of the Pharaohs that a watch was set upon them when their services were required in preserving the body of a young woman. The superstitions of the incubus and vampire, which figured extensively in the witchcraft trials of the Middle Ages, may have had their origin in this crime and the horror which it inspired.

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[1] See also Fournier: "Clitorisme," "Dict. des Sciences Médicales," vol. v., p. 376.

[2] "Handbook," vol. iii., p. 191.

There seems little hesitation among alienists who have treated of necrophilia (Krafft-Ebing, Maschka, and Legrand[1]) in saying that such an outrage upon decency could only have been the result of the working of a diseased mind, an opinion which certainly appears based upon a fair and charitable presumption. Maschka (*op. cit.*) holds that the criminal should, in every case, be examined as to his mental condition; nevertheless there is not a case upon record, so far as our investigation has shown, in which there has been an investigation. The question was not raised in the cases which occurred in New York City, but the perpetrators were individuals whose sanity was never before questioned. It requires considerable experience to overcome the natural repugnance felt toward handling the dead by almost every one. When, however, this instinctive dread is conquered (these men were morgue attendants) it may conceivably become easy for a diseased imagination to picture coitus with the bodies intrusted to his care, and it is but a step from this to the actual commission of the crime when opportunity offers. We have no explanation to offer for cases like the following, which seems to have arisen *de novo*. Krafft-Ebing[2] thinks that "an idea just as in lust-murder and analogous cases is accompanied by lustful feelings, and this leads to the impulse to indulge in acts of necrophilia," an explanation which hardly explains in this instance.

De Boismont[3] relates the history of a necrophile who bribed a watchman to gain entrance to the death-chamber of a girl of sixteen belonging to a French family of social position. He was caught in his night-dress by the mother, springing from the bed where the body lay. It was at first thought that his object was robbery, but his real intentions were soon laid bare. It was found that the criminal had violated a number of bodies

[1] "La Folie," p. 521.

[2] "Psychopathia Sexualis," p. 67.

[3] Gazette Médicale, July 21st, 1859.

previously, and he was sentenced to imprisonment for life. Taxil[1] tells the story of a priest whose form of sexual gratification was to use a prostitute dressed as a corpse and surrounded by all the usual decorations of the chamber of death. Here and in one other instance which we shall cite,[2] Krafft-Ebing's explanation seems more reasonable. The madness of lust drove the psychopathic unfortunates to the perpetration of their horrible acts. Moreau is responsible for these notes: a man, aged twenty-three, attempted to violate a woman of fifty-three. She resisted; he killed her by strangulation, and then raped her. To hide his crime, he threw her body into the water, but dragged it out again for renewed violation. He was executed for the murder, and at the autopsy the meninges of the anterior lobes of the cerebrum were found adherent to the cortex and much thickened. Other cases of necrophilia are reported by French writers, one of which was that of an idiot who was the victim of a periodical mania.

The crime is provided for in the Austrian statutes, section 306. There has been no legislation upon it in any English-speaking country until within recent years, when it was proscribed and a maximum penalty of twenty years' imprisonment placed upon it by the legislature of the State of New York.[3] It was forced upon the legislators' attention by a rape on a body in the New York City Morgue, perpetrated by one of the attendants who was caught in the act. There was no law to cover the case, and the man was released. No notes have been preserved of the history, but these are the main facts preserved in the memories of many people connected with the Morgue even after the lapse of ten or eleven years. In a few years, the passage of the legislation referred to was secured, not too soon, for in 1891 the occurrence was repeated. The Morgue attendant was found by a physician and the keeper upon a female body. He confessed in order to save himself as far as possible, and received a sentence of five years. The case has, of course, not been heralded to any extent, but may be found in the records of the police courts at that time.

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[1] "La Prostitution Contemporaine," p. 171.

[2] "Psych. Sex.," p. 68.

[3] See Rust's "New York Penal Code and Criminal Procedure," 1891, chap. v., p. 63, sec. 303, clause 4: "A person, who attempts sexual intercourse with a dead body, is guilty of the detestable and abominable crime against nature, and is punishable with imprisonment for not less than five nor more than twenty years." The legislators evidently regarded the offence as in the nature of sodomy rather than rape.

Physical evidence of necrophilia would be difficult to obtain in case the crime were not seen. Unless the girl could be proved to have been a virgin, in which case tears might be found in the hymen, vagina, and fourchette, together with, perhaps, scratch-marks on the vulva, we should be inclined to the opinion that it would be impossible. If ejaculation has taken place, spermatozoa found about the genitals would furnish corroborative testimony within the limitation of a possible connection before death.

Note to p. 431.

We cannot accept the claims of Voisin (*Rev. de Thér. Méd. Chir.*, April 1st, 1894) that the rupture of the hymen produced by masturbation can be readily distinguished from that produced by criminal assault. Moreover, the results of masturbation and criminal assault may be present at one and the same time, and in by far the greater number of cases the medical expert can swear to nothing beyond "penetration by some blunt instrument." The signs of masturbation, however, in a small proportion of our 176 cases, were well marked.

Such were an hyperdevelopment, multiple folding, and excessive pigmentation of that lateral half of the prepuce which corresponded to the masturbating hand. The same changes were found in the labia minora on that side.

Slight rupture of the hymen occurred, usually on one side only (the side corresponding to the masturbating hand), and at this point adherence of the hymen to labia minora by cicatricial tissue at the point of rupture often resulted.

UNNATURAL CRIMES.

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UNNATURAL CRIMES: SEXUAL INVERSION; BESTIALITY, PEDERASTY, TRIBADISM.

GENERALITIES.

It is said that all the motor forces of life may be reduced to two, namely, the preservation of the individual and the continuance of the species. Notwithstanding the fact that these great incentives are more or less modified or transformed in appearance by civilization, it requires but small reflection to recognize the truth and wisdom of the assertion concerning what are at bottom the source and spring of most human actions.

Aside from volitional incitation, the sexual, in common with the other appetites, is influenced by the activity of the cerebro-spinal centres, as witnessed in the well-known effects of imagination in this respect; while all the senses, smell, sight, sensation, etc., act with a certain amount of energy upon the genital sense itself, which, moreover, presents the same morbid anomalies as other functions of the body.

Since each author has treated the subject from his individual point of view, clinical, anthropological, or medico-legal, there is far from being unanimous accord as to whether or not anomalies of the sexual instinct are pathological manifestations. The matter of sexual criminality is one that has perplexed magistrates, jurors, lawyers, and medical experts, and has troubled the conscience of judges. Its study, really polyclinic in scope, touches upon questions of social pathology, teratology, mental alienation, and morbid psychology. While history and physiology teach that sexual crimes are marks of weakness and decadence, there is a more recent tendency among scientific men and medical jurists to place them in the category of abnormities, since the facts show that such manifestations ordinarily occur in degenerate individuals in whom the sexual instinct is the point of least resistance. It is now generally admitted that the majority of such cases are owing to hereditary predisposition, and that their phenomena are essentially pathological. Such appears to be the present status of the question among genitalists. In fact Krafft-Ebing, Charcot, Rabau, Magnan, Kowalewsky, Moll, Bourneville, Gleg, Tournowsky, and other authors are unanimous on this point. Different writers also admit that these syndromata of nervous heredity in their different forms may develop spontaneously, or they may be provoked by such agents as the license of literature and the stage, the privation of women, excess and separation of the sexes; and may range over a curious and monstrous field all the way from examples of indecent exposure or exhibitionism up to the hideous crime of profanation of the dead.

It is an error to suppose that sexual crime is confined to any species, time, race, or social class. Evidence shows that unnatural crime exists under all latitudes. It extends from the prehistoric time of the troglodytes up to Hippocrates, who brands it in his oath, and from his time to the present, when a prurient public is regaled with the sexual litigation of divorce and breach of promise cases, club scandals, and the filthy reports of the journals. Only of late one may find in looking over the medical journals cases of bestiality reported in such widely different places as Buda-Pesth and Philadelphia; while it is estimated by one authority that questions relative to the sexual instinct and to the function of reproduction count for three-fifths of the law cases in France. M. Lacassagne, professor of legal medicine in the University of Lyons, who has collected 2,500 cases with complete details, says that such cases become more and more numerous, and that they form a good third of those tried in the court of assizes. According to another authority, in 1888 there were 25,000 adult uranists in Germany, while Moll estimates 4,000 male sexual perverts in Berlin alone. Compared with New York, Chicago, or San Francisco, for instance, the much-exaggerated Pompeian evidences of unchasteness dwindle into insignificance. If one of our large cities were suddenly destroyed and the records of such matters left, the persons reading them might correctly infer that Pompeii was only an adobe village in comparison. The prevalence and spread of sexual crime, therefore, merits scientific study, to the end that both clinical and legal medicine may have clearer knowledge on this point.

German investigators, with characteristic methodical exaggeration, have introduced many new and confusing terms and elaborate classifications which tend rather to obscurity for purposes of forensic medicine.

Nosologically the subject of unnatural deviation of the sexual instinct may be considered under three categories, namely:

1. *Abolished* sexual function, as in impotence or agenesia;
2. *Exaggerated* or extreme sexual passion, known as *satyriasis* in the male, and as *nymphomania* in the female;
3. *Perverted*, as in the phenomena of uranism, fetichism, massochism, and sadism.

In the interest of terminology it may be well to define the last-mentioned, which are merely complications of sexual inversion.

By *uranism* is meant the violent sexual passion that an individual conceives for one of the same sex. "Greek love" is a synonymous term.

Fetichism,[1] the venereal excitement caused by part of the body of a woman other than the genital organs, or by objects of an insensible nature, as a piece of her dress. *Azoöphilia* is another term to express this morbid feeling for insensible objects, or those of an inanimate nature, a statue for example.

Massochism is that state of perversion in a man whose greatest sexual enjoyment is to feel subjugated and even maltreated and beaten by a woman.

Sadism, the opposite of massochism, is a combination of voluptuousness and cruelty, in which the sexual inclination manifests itself by the desire to beat, to maltreat, humiliate, and even kill the person for whom the passion is conceived.

Violent sexual passion of an individual for another individual of the same sex is known as *Sexual Inversion*.[2] It is also spoken of as *homosexuality*. Such morbid attraction among men is known as *pederasty*, and among women as *tribadism*.

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[1] Binet: "Le Fetichism dans l'Amour," Paris, 1888.

[2] A phrase now used by the best writers to express this reversal of the natural order of things. See Charcot and Magnan, also Tamassia: "Sul l'Inversione del Istinto Sessuale," Riv. Sperim., 1878, pp. 97-117; Chevalier, J.: "De l'Inversion Sexuel au point de vue Médico-légale," Lyon, 1885; and Zuccarelli: "Inversione Congenita dell Istinto Sessuale," Napoli, 1888.

The manœuvres of either sex to produce the venereal orgasm independently of the conditions of normal coitus, and known comprehensively as genital abuse, appear from many startling clinical facts to prevail to such an extent as to call for more extended study. The question is one of social hygiene, touching mental pathology on many points. There is consequently a call for better understanding by physicians and lawyers as to specific acts, since medico-legal intervention may require consultation and advice to pass upon the mental state and responsibility of an individual, in order to determine whether a certain act is the result of unsound mind or merely one of a libidinous nature. A physician, reading over the laws relating to unnatural crimes, cannot resist the conclusion that their incompleteness is owing to the want of clear and explicit medical knowledge of the subject. On the other hand, to many members of the medical profession the particulars of the afore-mentioned acts are totally unknown, while many others, actuated by virginal modesty or from feelings of false delicacy, shrink from exposing the turpitude they constantly meet with. It is not then astonishing that the "apostles of purity" have censured physicians for neglect and backwardness in dealing with such matters. The late Archbishop of Canterbury, in a sermon a few years since, before the Medical Association at Birmingham, reproached the medical profession with a want of courage and candor in dealing with the whole question of "purity," so-called. Even the authorities on crimes and misdemeanors allude to the subject as "an infamous crime that strikes at the root of society, a heinous offence so horrible as not to be named among Christians,"[1] and other like phrases of a vague nature.

We shall therefore depart from the reserved and concise mode of statement heretofore adopted, and shall not hesitate to turn the search-light upon these unpleasant professional details.

THE PROHIBITION OF OBSCENE PUBLICATIONS AND THE LIKE.

Several important practical questions as to causes, prohibitory and repressive measures, and the like, have lately claimed the attention of legislators and others. Only last autumn we read of the "Congress against Impure Literature" held at Lausanne. It has been suggested that the subjects of genesic inversion may be the victims of an anomaly analogous to that of splanchnic inversion. Whatever may be the cerebral blot or abnormality of the genito-spinal area that brings about this physiological instability, there is at the present time a subtle and powerful influence in corrupt and immoral publications, indecent advertisements and newspaper articles, printed and pictorial, which tends, by concentrating the thoughts on the lower portion of the genital tract, to bring about much sexual depravity. The erotic effect of reading publications of the kind may affect the lower lumbar reflexes in such a way as to cause great anxiety, and bring about sexual hypochondriasis;[1] not to mention the fact of their influence as wide disseminators of immorality and as teachers of crime among the young, immature, ignorant, and sensually inclined; a class that constitutes by far the largest proportion of every community. The Sapphic literature that is yearly vomited forth by the Continental printers recently caused the railway book-stalls in Belgium to be closed. In English-speaking countries, societies for the prevention of vice have brought many of these human vampires of the printing-press to the attention of justice. Cases in point are the well-known action against Bradlaugh and Besant[2] for publishing "The Fruits of Philosophy," and the recent prosecution of Messrs. Vizetelly for publishing "Nana." Notwithstanding the "Indecent Advertisement Act" passed in England, failure to convict is the rule in such cases. It is probable that no thoroughly effective legislation will ever be brought about, and that such indecent publications as "The Elements of Social Science,"[3] quack advertisements entitled "Health, Vigor, and Manhood," and the outrageous reports and meretricious illustrations of newspapers will continue to appear in countries where speech is free and the liberty of the press unrestricted.

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[1] Russ. Cr., section 698, also Bacon.

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[1] See writer's "Sexual Hypochondriasis and Perversion of the Genesic Instinct," Jour. of Nervous and Mental Disease, November, 1892; also Virginia Medical Monthly, of same date.

[2] Convicted of the misdemeanor of publishing an immoral pamphlet, and both were sentenced to a term of imprisonment by the then Lord Chief Justice; but both managed to escape what many considered a merited punishment by a technical informality.

[3] "Earthly, sensual, and devilish," according to Dr. Agate in "Sexual Economy as taught by Charles Bradlaugh, M.P.," London, 1893.

Prosecutions for sending obscene matter through the mails in violation of the Federal Statute (sec. 3,893, Rev. Stat.) are of frequent occurrence.[1]

An additional provision prescribes a penalty for United States officers aiding the violation of the law, who "shall be deemed guilty of a misdemeanor, and shall for every offence be punishable by a fine of not more than $5,000, or by imprisonment at hard labor for not more than ten years, or both."

Even scientific and medical publications may come under the ban of condemnation and form the basis of a prosecution, if wantonly exposed in the open markets, with a wanton and wicked desire to create a demand for them and not to promote the good of society by placing them in proper hands for useful purposes.

A French publisher[2] was lately arraigned before a Paris tribunal for outraging public morality by publishing a translation of Moll's work on "Sexual Perversion," in violation of the law of August 2d, 1882. The gravamen of the charge, however, appeared to be that the work in question was "an infamous book whose German origin called particularly for severe repression." The defendant was acquitted.

In Chicago it is also complained with some show of reason (that is, demand for the book and its wanton and open sale to improper persons), that Krafft-Ebing's work on the same subject is debauching in its effects and panders to lascivious curiosity.

EXHIBITIONISM OR INDECENT EXPOSURE.

Among the milder forms of unchaste conduct that come within the sphere of forensic medicine are cases of indecent exposure. The question here arising as to just what constitutes an obscene act or gesture clearly depends upon circumstances. It is held that the public exposure of the person is most obscene, yet the necessary exhibition of the person to a physician is not only innocent, but is a proper act, dictated by positive duty. The condition determines the quality of the act. Thus the nude in art is not of necessity indecent, but it may be so conditioned as to come under the ban of condemnation.[1] Reports show that most persons charged with the crime of obscene exposure are old men of no occupation and of unsound mind. Exceptions, however, occur in the shameless exposure of girls afflicted with hysterical mania, imbecility, or nymphomania; and I know the case of a German boy in Baltimore, who was arrested and fined upon the complaint of several ladies who lived opposite to a club-house where he was employed, and from the window of which he daily exposed his penis to them in a lascivious manner. A German of forty years has just been sentenced in Washington for six months, for indecent conduct before several small girls in one of the public parks.[2] Indecent exposure may also be charged to innocent and absent-minded old men, who may be suffering from some local irritative disease that causes the frequent application of the hand to the sexual organs or the anus. Many persons may recall the case of an old professor of mathematics at a celebrated school on the Hudson River.

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[1] Some of the cases falling within the provisions of the statute are: United States *v.* Morris, 18 Fed. Rep., 900; United States *v.* Gaylord, 17 Fed. Rep., 438; United States *v.* Hanover, 17 Fed. Rep., 444; United States *v.* Button, 17 Fed. Rep., 731; United States *v.* Bennett, 16 Blatch., 338; United States *v.* Harmon, 45 Fed. Rep., 414; United States *v.* Smith, 45 Fed. Rep., 476; United States *v.* Clarke, 38 Fed. Rep., 372; United States *v.* Chesman, 19 Fed. Rep., 732.

[2] Affaire Carré, contre le Ministère Public. Audience des 12 et 19 Juillet, 1893.

SEXUAL CRIMINALITY IN ANIMALS AND BESTIALITY.

If crimes of sexuality were confined to the human species, we should not have an opportunity to study the biological beginnings of vice as observed in curious instances in animals, which incline us to ask whether these inversions of the genesic instinct are with them unnatural phenomena or rather an outward manifestation of an imperious functional want. Without exposing the details of the analogy upon which is founded the presumption, we are warranted in saying that as many of the lower beings in the zoölogical scale show virtues having analogy to those of man, we must expect to find parallel vices. Instances of sexual perversion have been observed in insects, turkeys, dogs, stallions,[3] elephants, and other animals. I have witnessed such manifestations among animals in the Regent Park as well as in the Washington Zoölogical Gardens, and I learn from trustworthy persons connected with these places that genital abuse is common among animals deprived of their liberty.

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[1] United States *v.* Smith, 45 Fed. Rep., 476.

[2] Washington Post, May 11th, 1894.

[3] In the United States Patent Office is an electrical appliance to prevent self-abuse in stallions.

It would be easy to multiply similar instances, which may be suggestive from a Malthusian point of view. We know that the female spider often kills and eats the amorous male; female birds will combine to drive away the male, and other analogous facts have been noticed in various species, such as that of sadism in a certain variety of southern lizard, the female of which on finishing the copulative act immediately kills the male and chews off his head. Whatever may be said of animals in this respect, the facts of zoölogy tend to support rather than antagonize our moral code. It is rather in the matter of bestiality that sodomitical intercourse with animals claims the attention of the medical legist.

UNNATURAL RELATIONS WITH ANIMALS.

The carnal union of man or woman with an animal has always been regarded by legal writers as "an infamous crime and misdemeanor." It is mentioned as one of the special crimes known as *Sodomy*,[1] by which lawyers mean "carnal knowledge committed against the order of nature by man with man; or in the same unnatural manner with woman; or by man or woman in any manner with beast."[2] The term sodomy is rather an inappropriate, mystical one, much employed in the Middle Ages by religious writers, and belongs rather to ecclesiastical than scientific style.

Bestiality, or lust for a living being of the opposite sex other than human, is regarded as high treason against humanity and a crime against the species. Happily, at the present day this monstrous sensual depravity belongs rather to history and to the study of mental alienation. The penal codes therefore show a discreet silence upon this crime, doubtless imitating Solon, who in his legislation did not prescribe a penalty against parricide, a crime which he supposed impossible.

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[1] For a legal *résumé* of the subject see "The Amer. and Eng. Encycl. of Law," vol. xxii., 1893.

[2] Russell: "Crimes and Misdemeanors," sec. 698.

Unnatural relations, forbidden by God and despised by man, are mentioned in the Bible from Moses to St. Paul.[1] They have, perhaps, existed from all time, as numerous citations from both sacred and profane literature go to show. In antiquity there were the sacred ram of Egypt; the serpents kept in the temple of Æsculapius, and the donkeys mentioned by Juvenal (Sat. VI., 332, 333), so much sought after by women who recognized the salacity of an animal that promised the most voluptuousness to hysterical insatiety. A quotation from Plutarch would seem to show that animal and individual relations of a culpable nature were widespread in the Latin empire; and from histories of the Middle Age we glean that the vice was more dominant than in antiquity. Soldiers in those days satisfied their passions on anything, mules, hogs, sheep, or fowls; and on the march, among the camp-followers, were richly caparisoned goats, kept for the use of officers and their friends.

It is not, therefore, astonishing that the frequency of the evil should have attracted the attention of theologians. In the fifteenth and sixteenth centuries, a favorite theme for sermons was sodomy and bestiality, as one will see who cares to run through the sermons of Jean d'Aquilæ, Savonarola, Cherubino di Spoleta, and others, not to mention the monstrous details to be found in the work "De Matrimonio" by Father Sanchez. Nor is it surprising that the question of unnatural fornication came up between confessor and penitent; that the matter should be mentioned in the *Regulæ Communes* (xxxiv.) of the Jesuits, and that penal sanction should be attached to bestial sin committed by a member of the clergy: "Item episcopus cum quadrupede peccans decem annos pœniteat, presbyter quinque, diaconos tres, clericus duos."

It is very easy to hurl anathema at another century and to say that such an epoch carries off the palm for corruption. In our day this crime, though less prevalent, is far from rare in the large cities. In France, Dr. Pouillet says, there are but few villages where the degradation does not exist among the inhabitants, and that cases of this kind are common in the courts of justice. Many persons who have done the slums of some of the European cities may recall performances between a woman and a donkey which were to be witnessed on paying

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[1] Judges, xix.; 1 Cor. vi. 10.

THE PRACTICES AND MANIFESTATIONS OF PEDERASTY.

It is doubtful whether observations such as the foregoing lend support to the statement that in the progress of humanity lubricity and civilization march hand in hand, since travellers have noticed that many facts to the contrary exist among primitive people, especially our North American Indians. The early discoverers are said to have noticed sexual crime in Peru, which is one of the excuses given by the Spaniards for the cruelty of Pizarro to the natives. Having spent two seasons among the Eskimo of Bering Strait, I have reason to believe, from circumstances not necessary to detail, that inversions of the genesic instinct exist among these people just as they do among our common humanity in other latitudes. The sodomical habit referred to, known as *pederasty*, is one of the oldest infamies of the Adamic race, and one for which the Mosaic,[1] Roman, and Caroline laws inflicted the penalty of death. Only a short time ago, hanging was the penalty for this crime both in England and America.

Biblical and classical writings show the spread of a vice that could not be arrested by the voice of the Apostle, the edicts of magistrates, nor the penalties attached thereto by the Casuists. The historical development of this subject would form a long chapter of curious but repugnant reading. The worship of Bael was only a masculine prostitution, which is also expressly mentioned in the Koran,[2] and for which Mussulman jurisconsults have prescribed a most severe penalty. According to ancient Mohammedan law, the justification of homicide by the party upon whom this crime is attempted is expressly stated. Cases are mentioned by Stovarinus and Fryer, where the victims courageously took the lives of their assailants; their conduct brought them the commendation and protection of the public.[3]

History informs us that Philip himself was soiled by this infamy; Cæsar, according to Suetonius, was "the husband of all women and the wife of all men," and Nero, Alcibiades, and Adrian were addicted to the passion. Even Horace, in the latpenetration of the body of a mare. The case being considered a "question of *novelty* and of some difficulty," was tried before several judges, who with that diversity of opinion that legal fiction assumes to exist among medical experts only,[1] did not agree as to the guilt or innocence of the accused.[2]

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[1] Leviticus xviii. 22, 23.

[2] Chap. vii., v. 79 and Chap. iv., v. 20.

[3] Cheevers (Norman): "Medical Jurisprudence for India," 1876, p. 709.

Another case of bestiality with a mare is to be found in 8 C. and P., 417.

The case of a negro boy and a cow, in a suburb of Washington, came under the observation of a medical practitioner and others. A few years since a young unmarried woman in the Capitol City was surprised *in flagrante delicto* with a large English mastiff. This was a matter both of police and medical knowledge. A similar case of "vaginitis from bestiality" is reported in the *Philadelphia Medical and Surgical Reporter*, July 22, 1893, p. 155, in which the culprit confessed to having unnatural connection with a dog. A case of bestiality with sheep is also lately reported in a medical journal from Buda-Pesth.

Among other genital idiosyncrasies of negroes coming to the knowledge of the Washington police is the old Scythian malady spoken of by Hippocrates and Herodotus, and observed by contemporary travellers in the Caucasus. A band of negro men, with all the androgynous characteristics of this malady, was some time since raided by the police upon information given by several medical students. The same race, a few years ago, had several gangs that practised a kind of phallic worship. An informant, who has made a study of skatological rites in the lower races, described a personal visit to one of these orgies, where a big negro with turgescent penis, decorated with gayly colored ribbons, stood and allowed his comrades to caress and even osculate the member. Performances of the same nature are known to the rites of voudouism. In New Orleans about the close of the Civil War, a voudoo society was suddenly surprised by the police during these ceremonies. Two of the naked persons taking part in the orgy were white women. The incident led to a famous trial which resulted in acquittal.

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[1] Current reports from the court of last resort, the United States Supreme Court, show thirty-five cases disposed of with as many different opinions, concerning which occur the familiar phrases, "Bench pretty evenly divided," "Reverses its own decision," etc.

[2] 1 Va. Cas., 307.

his fell purpose. Syphilis is often transmitted by this mode of coition, a fact described several hundred years ago. Since the work of Binet (1881) on infecting chancres of the anus, Martineau has observed twenty other cases (Lacassagne). A noted pederast, tried a few years ago in Philadelphia, is said to have communicated syphilis to a dozen or more victims. Some years since I saw at San Francisco, on board the celebrated Arctic cruiser *Corwin*, a case of syphilitic periostitis in a ward-room boy, who had been shipped by the executive officer without inspection. Being too young to have acquired venereal disease in the ordinary way, examination revealed the existence of a horrible mass of syphilitic sores about the anus and nates. The boy confessed that previously to his shipping on the *Corwin* he had served on board the United States ship *Alaska*, where men had used him as a passive agent for immoral purposes. Dr. Dickson, United States Navy, reports a similar case that he has observed in an apprentice boy of fourteen at the Washington Marine Barracks.

BUCCAL COITUS—IRRUMATION[1] AND FELLATION.[2]

The presence of chancres being observed in other parts of the body, as the mammæ, the axilla, and even the mouth, calls for the consideration of a hideous act that marks the last abjection of vice. So squeamish are some English-speaking people on this point that they have no terms to designate the "nameless crime" that moves in the dark. Many of the Continental writers, however, make no attempt to hide the matter under a symbolic veil, and deal with it in terms as naked and unequivocal as the old historians, from whom hundreds of citations might be made, and this, too, without incurring the reproach of pedantry.

A quotation from Erasmus shows that *lesbianism* had a place in his thoughts: "Aiunt turpitudinem quæ per os peragitur, fellationis opinor vel irrrumationis, primum a Lesbiis authoribus fuisse profectam."

The writings of the Casuists, so profoundly versed in matters of conscience and human vice, show unequivocally the same thing, as witnessed in the question, recommended to spiritual directors, especially those of Bishop Burchard of Worms, in the eleventh century; and some ecclesiastical writers even went so far as to express the opinion that they saw no mortal sin in the action of "virile membrum in os mulieribus immittere," nor in that of "virile membrum in os accipere."

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[1] These terms not being Englished, the following definitions are given: *Irrumare*—penem in os arrigere.

[2] *Fellatrix* dicitur ea quæ vel lingua perfricandi atque exsugendi officium peni præstet.

From writings of the genitalists references like these might be cited to a tiresome length; but to be brief, it may be said that inversions of the genesic instinct did and do exist among all people, and that numerous cases may be collated from current medical literature and from the archives of criminal anthropology and penal science. So prevalent indeed is this theme in literature that a prominent medical author says citations may be made from all the historians from Herodotus to P. Dufour; all the poets from Sappho to Baudelaire; all the naturalists from Aristotle to Mantegazza; all philosophers from Plato to Schopenhauer; all the romancers from Lucien to Sacher-Masoch, and all the law-makers from Moses to the Austrian legislators. A contemporaneous French writer says that "the fire and sulphur that destroyed Sodom and Gomorrah would scarcely satisfy to purify New Caledonia."[1] And Dr. Pouillet writes of buccal coitus that *irrumation* has become so habitual (*chez nous*) among the French that there are but few young men of this generation upon whom it has not been practised, and but few complaisant women or prostitutes who refuse to fill the office of *fellatrice*.[2]

As a reflex of this state of immorality it is only necessary to call to mind the unclean realisms of Zola, of Tolstoi, and of the French lesbian novels, "*Mademoiselle Giraud ma Femme*," by A. Belot, and "*Mademoiselle de Maupin*," by Th. Gautier, whose point of departure is tribadism. The same astonishing theme pervades "*Fridolin's heimliche Ehe*," by Hildebrand; "*Brick und Breck oder Licht in Schatten*," by Count Emerick Stadior, and "*Venus im Polz*," by Sacher-Masoch. In our own country the surreptitious sale of such publications is carried to such an extent that agents of the Post Office Department yearly capture and destroy tons of pornographic literature. In fact so much obscene matter comes to the Dead Letter Office that the postal authorities prohibit women clerks from opening the mail. Certain benevolent societies co-operate in the matter of suppression; but many of their methods for preventing vice and bringing about prohibitory legislation, though well meant, are both impracticable and reprehensible. Over-zeal has led to false philosophy and sophistry like that of the prohibitionists, who would have enacted sumptuary laws that interfere with the liberty of the subject. An organic necessity so imperious in its promptings as the generative instinct may not be controlled or suppressed in many of its manifestations by legislative enactments. In fact such measures would be about as ineffectual as an attempt to change some of the great physical wonders of the North American Continent.

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[1] For an account of these infamies see le Dr. Jacobus X—— "L'amour aux Colonies," Paris, 1893, pp. 267–313.

[2] See Luiz: "Les Fellatores, Mœurs de la Décadence," Paris, 1888.

That these degrading acts tend to spread more and more in the great centres of population, it is only necessary to recall what many have seen in the older cities of Europe, where women will commit the simulacrum of the virile venereal act for a small sum of money; where infamous scandals have occupied the attention of justice and the newspapers, and have even caused the expulsion of a member of Parliament, who is now in penal servitude for his crime. A vice that can hardly be said to have crossed the Atlantic with Columbus or with the austere pilgrims of the *Mayflower*, since the early explorers found it among the primitive inhabitants of Panama and Peru, has caused social scandal and lawsuits in New York, and murder and divorce in Chicago, San Francisco, and far-away New Zealand.

Perhaps it is more to the point in this respect to study the details of one's own city. What is true of Washington, for instance, as regards sexual matters doubtless applies more or less to American large cities.

A physician whom I see almost daily tells me of a case of venereal disease of the buccal cavity in an old soldier he is treating. The patient with unblushing effrontery did not hesitate to say how it was contracted. The medical details of various other cases reported to me by local physicians could also be recited.

From a judge of the District police court it is learned that frequent delinquents of this kind have been taken by the police in the very commission of the crime, and that owing to defective penal legislation on the subject he is obliged to try such cases as assaults or indecent exposure.[1] The lieutenant in charge of my district says that men of this class give far more trouble than prostitutes. Only of late the chief of police tells me that his men have made, under the very shadow of the White House, eighteen arrests in Lafayette Square alone (a place, by the way, frequented by Guiteau) in which the culprits were taken *in flagrante delicto*. Both white and black were represented among these moral hermaphrodites, but the majority of them were negroes.[2]

Another instance is that of a sanctimonious young man who frequented a certain religious association in order to entice victims of this singular abuse.

CONDITIONS AFFECTING SEXUAL INVERSION.

As to the influencing conditions of the morbid phenomena in question, age, sex, and station of life may be considered. Aside from such exclusive agglomerations as soldiers, sailors, and prisoners, sexual inversion does not appear to be confined to any degree of the social scale; yet the statistics in this regard go to show that certain callings furnish a greater number than others. According to the best authorities actors head the list, especially those accustomed to performing the parts of women.[3] Exceptions to the statement may, however, prevent one from generalizing in too absolute a manner, although Caspar and others are of decided unanimity on this subject, while Moll says that the only profession that seems suspicious in this relation is that of the actor disguised as a woman; that men who from preference take the rôles of women appear often to suffer from sexual perversions. The next in order of frequency come decorators, hair-dressers, and ladies' tailors. It is suggested by way of explanation that the peculiar inclinations of these individuals may result from the fact of their being morphologically male yet psychologically female. Others speak of abnormal distribution of the genital nerves to the rectal mucus, and of such individuals as psycho-sexual hermaphrodites, or, more speculatively, as suffering from some disturbance of the genital sphere, localized about the olfactory centre, which causes a lesion of this autonomy.

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[1] It appears by the ancient authorities of law that this was felony (12 Co., 36). See also Sir James Stephens, "Crim. Law Dig.," p. 103.

[2] See McGuire and Lydston: "Sexual Crimes among the Southern Negroes," Louisville, Ky., 1893. Observation shows, however, the rarity of sexual perversion among the aboriginal blacks.

[3] Notably so in China, where they go further and play the rôle of woman *au naturel*.

It has also been observed among spiritualists, and mediums in particular, that one finds a large number of individuals exhibiting the phenomena of sexual perversion. Hartmann[1] and Moll cite late instances of successful mediums suffering from this malady. Religious instinct so often goes astray in this regard as to impress all philosophers and all physicians with the narrow blending line that divides religious exaltation and erotic perversion. Many hypochondriacs pass for religious when they are merely suffering from sexual neurasthenia; and it is a fact known to others than physicians that so-called religion and erotic debauchery often go together. For this reason much that is found in our "land of spiritualists, mesmerism, soothsaying, and mystical congregations" may be looked upon with suspicion.

By many the Jews were supposed to figure largely as sexual perverts; but lately published facts show the incorrectness of this supposition and even the smaller proportion than in other races. Compared with cases among individuals who help to make up the "Salvation Army," or with the evangelical performances in Brooklyn of *De Cobain*, now in penal servitude, there seems to be no difference between Jews and others in this respect.

Deviations of the sexual instinct have been observed from the age of sixteen up to eighty-two years. They are said to be more common in men than in women, Kraft-Ebing observing but 11 women out of 198 recorded cases. Other writers on criminality, disposed to question the correctness of the assertion, say that the graver forms of sexual inversion, either congenital or acquired, are usually met with in men, but the minor anomalies are more prevalent among women, owing to their greater affectibility. On the other hand, while pederasts show an aversion for the opposite sex, they are noted for effeminateness, falsehood and dissimulation, a tendency to hysteria, excessive prudery, and inordinate fondness for jewelry.

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[1] "Nachträge zur Phänomenonologie des Unbewussten."

TRIBADISM.

If crimes of sexuality were confined to men, the lesbian habits of women would furnish no material for comment. There seems to be a difference among authorities as to the relative frequency of sexual inversion among women. Dr. F. Claye Shaw, speaking of the sexes in lunacy, says that in language women hold the palm for volubility, abuse, and foul-mouthedness. There is no difference in this respect between the barefaced virago from the lowest parts of the town, and the fashionable women from the best quarter.

Certain it is that noise, filthy conduct, and sexual depravity, both by speech and act, are much more common on the female than the male side of an asylum.[1]

According to Moll all sorts of sexual perversions are found among women, the one most frequently met with being inversion, in which the woman feels herself drawn not toward man, as she ought to do normally, but toward another woman. The act by which "*una fellat lingua clitoridem alterius*" has also received the name of *Saphism* from the poetess Sappho, who it seems is greatly libelled thereby, since the best critics think she merely wished to depict the tendencies of women in the Lesbian epoch. *Clitoridism* is a synonymous term applied to the act performed by a woman with exaggerated development of the clitoris, who uses this means to abuse her own sex.

The vicious habits of tribadism, like those of pederasty, are widespread, and have a history and ground of consideration of their own. In countries where harems and polygamy abound, saphism is a fashion that has long prevailed. Though an old vice, its scientific study is of relatively recent date.

It is difficult to say among what class or station of life tribadism most prevails. One of the wives of Henry VIII., Catherine Howard, is said to have been condemned to death because of homosexual habits; but like many historical anecdotes it is of doubtful authenticity, and not susceptible of proof.

Better established are the lately reported "biuterine marriages" and sexual relations between actresses, waiter-girls in beer gardens, and public women, among whom tribades are found in the greatest number. Dr. Moll says that he knows to a surety that twenty-five per cent of the Berlin prostitutes indulge in sexual relations with other women. Many cases of tribadism are also reported in married women, among whom liaisons extending over several years have resulted in breaking up households. A strange case of this kind published by Duhousset in 1877, is that of two tribades, one of whom after marrying resumed the liaison with her former friend, who became pregnant. Although a little mystifying, it is possible that the married woman in leaving the embrace of her husband for that of her friend transported a small quantity of fecundating fluid. Other cases of the kind are reported, but the details are not authentic.

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[1] St. Bartholomew's Hospital Reports, vol. xxiv., 1888.

Analogous to the same feeling in the male sexual pervert, there exists on the part of the tribade indifference, antipathy, or profound repulsion for an individual of the opposite sex.

But, strange to say, homosexual women have not the same defects of character as male perverts; many of them having a horror of falsehood and of vice in general. Jealousy among them seems to be most powerful and ungovernable, even extending to murder at times. A case of morbid love in which one young women killed the other was tried on the eastern shore of Maryland a few years ago. The recent and well-known case of Alice Mitchell is still another in point.

Owing to the lack of facility in studying homosexuality in women, and the lesser number of facts relatively thereto, the details of this vice among them are not so well known as are those of pederasty in men. Many particulars as to the existence and spread of saphism have been learned by neurologists, who, it seems, are more accustomed than others to look into the muddy bottom of the heart and into the dark corners of human nature.

I know the case of a prostitute who from curiosity visited several women who make a specialty of this vice, and on submitting herself by way of experiment to the lingual and oral manœuvres of the performance had a violent attack of hysterocatalepsy, from which she made slow recovery.

Through a patient of the opposite sex, another case has come to knowledge of a woman who practises the orgies of tribadism with other women after getting them under the influence of drink.

A recent case of "neurasthenia," in which an unfortunate love-affair was suspected to be at the bottom, was that of a young woman, who after much hesitation confessed to me a liaison of the kind with a woman who was a "faith-cure" or "Christian Science" practitioner. The patient said that this woman with a sort of mesmeric influence had completely subjugated her will to the extent of making her break off a very desirable engagement of marriage, and that she was only one of several young women who had come under this fell influence.

A modification of this form of perversion, though mentioned by writers of antiquity, has lately been discussed in more recent works. Krafft-Ebing and Mantegazza mention instances of women who employ lap-dogs for a sensual end, and Moll reports that he was consulted by a married woman who, fearful of contracting disease, confessed the habit of allowing a pet dog to lick her genitals until complete satisfaction ensued.

Many instances like the foregoing might be cited with sickening detail from the annals of foreign medicine. Although it is true that the practices described are ancient and known to physicians and magistrates, yet judiciary medicine happily has but little to do with mono-sexual adultery, either pederastic or lesbian, in English-speaking countries. Besides, they are not a subject of legislation and seldom come before a court, except in the case of divorce, where the practice of unnatural crime is alleged on the part of the husband as a cause for granting a decree. Moreover, the vulvar and other deformities[1] described as physical characteristics of tribadism have not yet taken a recognized place in legal medicine.

POINTS TO BE OBSERVED IN REGARD TO THE EXAMINATION.

In the case of a charge of unnatural crime, the physician may find himself on a rogatory commission whose function is to determine whether the alleged outrage is a crime or merely a pathological phenomenon. An expert examination with this end in view should, therefore, be extra-careful and severe, and conducted with great reserve and even over-scrupulous prudence, since a single accusatory word from the physician may sound the note of infamy or lead to a suspicion that blights a reputation beyond recovery. From its nature, says Blackstone, the offense is so easily charged, and the negative so difficult to be proved, that the accusation ought clearly to be made out. The evidence should be plain and satisfactory in proportion as the crime is detestable.[1]

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[1] Martineau: "Leçons sur les Déformations vulvaires et anales," 1884.

For this reason similar accusations against certain historic personages may be the calumny of enemies, which, in the absence of unequivocal proof, should be accepted with considerable reserve. In an accusation of this kind, the time of day when the offence was alleged to be committed should be carefully noted. In fact many of the precautions taken in cases of identity or in rape apply in a measure, as they may bear upon an *alibi*, for instance, or may in some manner lead sooner or later to the support or abandonment of the accusation.

Usually there is not much objection on the part of the accused to submit to medical examination. In case of refusal the expert should not insist, but merely point out to the individual the inconveniences that may result from the abstention, and he may note the refusal on his report.

Medical evidence, rarely asked for in cases of indecent exposure, is usually for the purpose of determining the existence of certain diseases, or of some form of mental unsoundness (see Tattooing, p. 423, Vol. I.)

Opinions of medical men have also weight with the postal authorities and others in regard to the distribution of obscene or indecent publications, which are held to be obscene libels, and for that reason non-mailable.[2]

A possible judiciary curiosity in connection with the subject is the suit of a man in Kentucky, whose grievance appears to be that another person called him "Breckinridge."

IN CASES OF BESTIALITY.

Unless taken in the act, the only medical evidence of value in cases of bestiality is the identification of *hairs* of the animal on the accused, or the finding of suspicious spots, stains, etc., upon the clothing. It may, however, be difficult to prove that the origin of the several spots is one and the same, or that the blood corpuscles or spermatozoids discoverable by the microscope are those of man or some other animal.

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[1] Blackstone, "Commentaries," 215, p. 926.

[2] 2 Wharton, "Cr. Law," sec. 2,545; also Com. *v.* Landis, 8 Philadelphia, 543, and R. *v.* Hickling, 3 Eng. L. R., Q. B., 360.

IN CASES OF SUSPECTED PEDERASTY.

Suspected seminal spots and fecal matter on the undergarments do not avail much as evidence in alleged pederasty, although with corroborative proof they may be of importance in supporting the charge. In conducting an examination in a suspected case of this nature it is well to get all possible information as to the antecedents of the accused; his genealogy, history, present health, general appearance and habits, intelligence, and all signs of degenerescence.

The genitals, the anus, and nates call for special examination with a view to finding the pederastic signs that may throw light on the active, passive, or mixed criminality of the person charged.

The medical appearances said to be the result of pederasty in the *active* male criminal are relaxed and pendulous sexual organs, elongated penis, with bulbous and conical glans, and twisted urethra.

In *passive* criminality the supposed characteristics are redness, excoriations, fissures, tears of the anal region, with effacement of the folds and smooth appearance of the skin of the part, a peculiar funnel-like depression of the anus with relaxation of the sphincter, and incontinence of the feces.

In the *mixed* forms the effect of both active and passive criminality are united.

Many of these signs are, however, by no means specially characteristic and are at times absent even in notorious criminals. They may also result from other than criminal practices, as the sequel of a surgical operation or a real infirmity. On the other hand, it should be clearly understood that the absence of these signs is not absolute proof of the non-commission of the crime. The only form of conclusive medical evidence possible in such cases appears to be the finding of a gonorrhœal discharge, or a chancre within or at the verge of the anus. A medical witness should therefore depose as to the suggestiveness only of certain appearances, which may have occurred from natural causes, and he should be content merely to state whether or not, in his opinion, they are consistent with the commission of the crime.

The question of tribadism rarely comes before a court. Many are inclined to look upon this practice rather as a social monstrosity, which like incest carries with it its own just punishments in the form of prompt mental and physical degeneration, and does not properly come within the range of legal medicine. Besides there are no characteristic appearances by means of which the commission of the act may be proved.

Supposing the guilt established, a more delicate and difficult question arises as to the mental state and responsibility. This of course depends upon the signification furnished by the symptoms to be gleaned from the study of social and individual causes, and mesological conditions; from the defects of organization, as vice or arrest of development, lesion of the nerve centres, heredity, femininism, and other factors concerned in the production of the anomaly.

If a manifest hereditary state can be established, showing instinctive impulses in young age with important nervous or psychopathic troubles, a fair and reasonable conclusion may be reached as to the criminal responsibility of a subject of sexual inversion. The anomaly is the manifestation of a grave state, which Westphal first appears to have regarded as a morbid episode dependent on mental aberration. Others now recognize this hereditary neuropsychopathy or inborn, sickly disposition, which impels to acts that the will is powerless to repress, and consequently brings about irresponsibility. It is held that such phenomena are irresistibly morbid; that a patient of this class is not a culprit, but rather a lucid fool to punish whom would be a misconception and an anachronism.

From the criminal point of view the expert should bear in mind that he may have to deal with exaggerated charges, simulation, and attempts at blackmail. Cases of this kind have occurred in which the accusations were totally false and unfounded. Taylor, mentioning the case of a man in Jamaica, sentenced for life for an alleged crime of this nature that he had committed upon the plaintiff during sleep, expresses the opinion that the accomplishment of such an act during natural sleep is contrary to all probability.

It appears from different legal authorities that it is not necessary to complete the act to constitute the offence, since the mere soliciting another to the commission of the crime has been treated as an indictable offence.[1] An accomplice is regarded in the same light, and in some of the States and in England the *attempt* is deemed to be a misdemeanor.

A criminal simulation of a graver character is cited of an assassin who tried to impart the belief that he had committed murder to escape a pederastic assault.

Acts of this nature are not always the necessary consequence of insanity. Sexual crimes of the most shameful and revolting character, such as profanation and mutilation of the dead, have been committed by individuals held to be sane. Legrand du Saulle[2] mentions a series of cases of this almost inconceivable monstrosity, and shares the belief of Morel that there is in reality no act so depraved, committed by the insane, not even excepting the violation of cadavers, that has not been accomplished by individuals in full enjoyment of their reason (see Necrophilia, p. 487).

But in making an expert survey to determine the criminal responsibility, or it may be the civil capacity,[3] of an individual accused of sexual crime, conclusions should not be based upon the nature of the libidinous acts alone. The examination should be conducted upon the lines best adapted to show whether the accused has yielded to an unhealthy and irresistible incitement, or to the suggestion of his passion.

For additional information on this subject see case of Julius Krueg, *Brain*, 1881; case of Alder Blumer, *Am. Jour. of Insanity*, 1882; case of Wise, *Alienist and Neurologist*, 1883; Savage, *Jour. of Mental Science*, 1884; Wacholz, Dr. Leo, *Friedreich's Blätter für gerichtliche Medicin und Sanitätspolizei*, Nürnberg, 1892, XLIII., 431; *Maryland Medical*

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[1] 2 Chit. L., 50.

[2] "Traité de Méd. Lég.," Paris, 1886, pp. 397–402.

[3] President Cleveland has lately (June 23d, 1894) declined to restore to citizenship W. W. Knott, of Chicago, who served a term at Joliet for sending lewd circulars through the mail. The President's indorsement is: "Denied—Before I return to this convict his rights of citizenship I must be abundantly satisfied that he is living a decent life, and engaged in a decent occupation." Knott wrote a dirty novel called "Stolen Sweets," and the circulars which he sent out about it were worse than the book itself.

Journal, 1893, XXIX., 199; Chevalier, J., "Une Maladie de la Personnalité," Lyon et Paris, 1893; *Annales d'Hygiène*, 1893, 3 S. XXIX., 457; "Epilog zum Prager Prozesse Waldstein," *Wiener medizinische Wochenschrift*, 1893, XLIII., 147; Krafft-Ebing, R., "Der Conträrsexuale vor dem Strafrichter," 1894.

RAILWAY INJURIES:

THEIR

CLINICAL AND MEDICO-LEGAL FEATURES.

BY

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RAILWAY INJURIES, THEIR CLINICAL AND MEDICO-LEGAL FEATURES.

INTRODUCTORY.

CONSIDERING the importance of medico-legal testimony, the existing status in this country of the medical expert, the lack of proper instruction on medico-legal subjects, and the loose, the thoroughly warped opinions, antagonisms, and oftentimes self-defeating actions of the medical expert, which have brought the medical profession almost into contempt, are astounding. Certain it is that the respect accorded the profession of medicine in this matter is not commensurate with its intelligence; and there should be some endeavor to correct this condition if possible. The loss of individuality, and the subserviency on the part of the medical expert, due in many cases to his relations to the party employing him; and the adaptation of medical opinion to a theory built in law, be it true or not, often prevent the procurement of unbiased opinion.[1] This is pre-eminently true in cases of personal injuries occurring upon railways, where an almost inherited prejudice enables the most ignorant quacks to give expert testimony. Possessing scarcely the elements of true medical education, these impostors are accorded credence equal to that given the most skilful of experts. So prevalent has this practice become, that we have heard reputable lawyers say, that with the railway to be opposed in a legal trial, the ignorant medical witness will exert more influence over the average court and jury than the well-posted and honestly inclined medical ex-

[1] Reform in the methods of using medical men as experts is a plant of slow growth. Suggestions and recommendations are offered in sufficient number, and there the matter ends. English and American courts continue to follow traditional usages, and show no willingness to find a better way. Each of the parties in a suit in litigation secures the services of medical witnesses favorable to him, and leaves the witnesses to justify their testimony as well as they can; this being in accordance with the theoretical right of every person to call, on behalf of his defence, such witnesses as he sees fit.—Winthrop: Draper Annual of the Universal Medical Sciences, 1893.

pert. It is not ignorance that has brought about this deplorable condition of medical expert testimony, but duplicity, dishonesty, and the ready adaptation of the medical expert to the views of the counsel. The lawyer himself, rarely competent in his knowledge of medicine to make plain the learning, competency, and proficiency of the genuine expert, is as equally certain to fail to detect the ignorance and utter incompetency of the ignorant expert. The value of the medical expert's testimony should mainly depend upon the expert's proficiency and learning in his profession. But this is very far from being the case in practice. None is so well able to judge of the competency of the medical expert as one in the same profession. Yet medical indorsement of the medical expert is rarely accepted, because there is naturally aroused an idea of professional jealousy. Hence there is only one course left; and that is to accept existing conditions, and aim to correct them by time, education, and example. Honorable, just compromise should be encouraged, whenever possible, with a desire to do strict justice. The field of compromise is one where honorable professional men rarely disagree; where dignity is maintained, and a truthful, manly standard. Compromise will oftentimes permit a much nearer approach to strict justice than a court, which necessarily permits the conflict of truth and falsehood, frequently to the exclusion of justice. Compromise generally offers to all concerned the purest and best form of economy; for the plaintiff it takes away the sting of delay and irritating circumstance; for the corporation it saves money and reputation.[1]

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[1] Thus, H. W. Sheldon, a lawyer of excellent judgment, describes the abuse and indicates the remedy in these words: "The evils by which the value of medical testimony in a court of justice is lessened are mainly two—the learned disagreement of theories, and the stretching and straining of professional skill to reach the result required by the exigencies of litigation. Do not both of these evils spring from one cause, the arbitrary and unrestrained voluntaryism of our system, by which each party selects those and only those experts whose testimony will avail him, and, so far as he may, shuts the mouths of the equally competent, sometimes more skilled and learned experts, whose weighty opinion would not bolster up his cause? Our courts have found it advisable to refer complicated and intricate matters of account to auditors, whose conclusions are usually found to be of great assistance to the court and jury. Is there any practical difficulty in our following the example set us in some of the countries of Continental Europe, and having medical experts appointed by the government either *pro hoc vite* or for some fixed term of office, who after such investigation as might be necessary should speak judiciously and not as hired partisans, and whose reports might be made at least *pri-*

Our only excuse for writing upon railway accidents and their medico-legal consequences is that by attempting a special study of them, the medical and legal professions will possibly be led to give this subject more careful attention; and by placing these injuries under one heading they will be more ready of access, and possibly be the means of guiding experts and others in a line of thought which may be of use and value. We realize in the beginning that in treating of railway injuries we are not describing new and unknown affections; for, in general, the injuries done upon railways differ from those inflicted in other ways, only in degree and circumstance. At times, however, the intensity of the forces and the peculiarities of the circumstances at work, place railway injuries almost upon the plane of specialism. In no class of injuries inflicted upon man do we so often see the combination of the extremes of psychical and physical shock. Here we have great intensity of force producing excessive destruction of tissues, and inflicting all varieties of contused and lacerated wounds, with compound fractures, and compound crushes of hard and soft parts. In many instances such injuries are inflicted under conditions peculiar to railways; where excessive momentum, ponderosity, and rapidity of incidence are characteristic. Frequently the active agents producing these injuries have an intense, definite character, weighing at times hundreds of tons, and speeding through space at the rate of one hundred and ten or one hundred and fifteen feet a second.[1] The passage of rapidly revolving, ponderous wheels over parts of the human economy, certainly, in many instances, stamp the resulting injuries as original in degree. Tissues, vessels, and even nerves, are twisted, ruptured, and strained at points far removed from the original seat of injury; requiring a study not only of con-

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ma facie, perhaps conclusive, testimony upon medical questions submitted to them? Or competent experts might be appointed to act in a judicial capacity and not at all as witnesses, but solely authorized to hear the testimony of such medical witnesses as either party might produce before them, and report their findings to the court."—Winthrop, in Annual Universal Medical Sciences, 1891, F. A. Davis, Pub.

[1] Prout says: "To-day trains weighing four hundred tons thunder by at seventy-five miles per hour, and we hardly note their passage; but seventy-five miles an hour is one hundred and ten feet a second; and the energy of four hundred tons moving at that rate is nearly twice as great as that of a two-thousand-pound shot fired from a hundred-ton Armstrong gun."

ditions of parts obviously damaged, but also of the economy as a whole.

Realizing how little systematic work had been done in the grouping of railway injuries and their medico-legal consequences, it shall be our endeavor to give observations concerning all the elements which enter into their production, course, termination, and consequences; aiming to indicate as plainly as possible the essential factors which constitute their truthful history. We shall attempt to make their symptomatology as complete as possible, in the hope of giving truthful views, and enabling the practitioner to determine in their examination any elements of simulation, pretence, or exaggeration. It is true that in a great number of injuries inflicted by railways, exaggeration of symptoms seems to be the rule, and, for this reason, more than ordinary care is demanded to interpret aright the existing condition. There can rarely be much difference of opinion among educated and honestly inclined surgeons when plainly evident traumatisms and lesions present themselves, like contused or lacerated wounds, fractures, and dislocations. These are self-evident conditions, and as such can be but infrequently erroneously interpreted. It is in the field of subjective troubles, supposed lesions, or lesions which lack plainly evident signs, that opportunity is offered for simulation, exaggeration, and positive malingering of the most pronounced type. Take, for example, the condition called traumatic neurosis, first described by Erichsen, and finally by others as railway spine and brain. This subject has been studied and actively discussed by the medical profession since 1866. Probably no subject of recent date in medicine has received more attention and consideration than this trouble. For years this morbid entity was described as being peculiar to railways, owing to its frequent occurrence upon them. The serious state in which the patient was placed, its intense subjective character, the natural and subsequent litigation, and the extreme assessment of damages, made it a problem of great and unceasing difficulty of solution. Absolute diversity of competent medical opinion, its multitudinous symptomatology, and its psychological consequences, make it, at the present writing, the great enigma of medicine. Traumatic neurosis now includes the narrow appellation of railway brain and spine, since it is a condition that can occur under the most varied circumstances of life. Authors now attempt a proper classification of its symptoms, and order begins to emerge from chaos. The narrowness of earlier views has given way before broader, less prejudiced, and honest scientific study.

Another recently described condition, which is asserted to be connected with railways, and expressed almost entirely by subjective symptoms, called "Internal Entasis," will receive consideration; and an effort will be made to give all its relations and describe its pathogeny. Again, knowing how extremely imperfect are the present methods of making civil medical expert reports, we shall endeavor, by illustration from existing literature on this subject, to show the system inculcated and practised by competent examiners. For the assertion is true and well timed which says, "Through some defective form or the omission of simple formality, a law-suit eternalizes itself."

It is granted that from a purely medical point of view this subject is not new; and, as indicated, it is only the attempt to combine the different elements of railway injuries, and to point out their application to legal medicine that possesses any claim to newness. If numbers, as indicated by the injuries occurring upon railways, be any justification for attempting to specialize the medico-legal question of railway injuries, the last report of the United States Interstate Commerce Commission certainly strongly justifies the attempt. Its last report shows that the number of men employed on railroads in this country was 784,280, being an increase of 34,984 over the previous year. Of these employees there were killed during the year ending June 30th, 1891, 2,660; and the number injured was 26,140. The number of passengers killed was 293, and the number injured was 2,972. And those cases classed as "other persons" bring the total up to 7,029 killed, and the number injured to 33,891; making a grand total of killed and injured of 40,910. It is safe to say that this does not constitute the entire number of injuries on railways by many thousands, as they rarely desire to advertise their accidents; but it is sufficient to indicate the importance and the immense destructive and injury-inflicting power of the railway.

CHAPTER I.

CAUSATIVE FACTORS PRODUCING RAILWAY INJURIES.

1st. Classification of causes.—Laws of liability.—2d. Mental conditions of employee.—Always an uncertain but positive causative factor in the production of accidents and catastrophes.—3d. Illustrations of heterophemy and auto-hypnosis occurring to employees.—4th. Causal factors of the catastrophes.—5th. Conditions necessary for the safe operation of the railway.—6th. Road-bed as a cause of accident.—7th. Curves of the railway as a cause of accident.—8th. Conditions diminishing the danger of curves.—9th. Dangers of the gradient as a cause of accident, modifying causes.—10th. Switches as a cause of accident—Virtues of the split-switch and stub-switch.—11th. The bridge as a cause of catastrophes.—12th. The small trestle or bridge more fruitful in accidents than the larger structures.—13th. Bridge accidents commented upon.—14th. Manipulation of trains as a cause of accident.—15th. Negligence of employees, and disease and overwork as causes.—16th. The rules of train-dispatching, if rigidly followed, a prevention of accident.—17th. Signals—The semaphore and the interlocking switch considered.—18th. Causes due to defective motive power.—19th. Inspection of trains.—Miller platform.—Westinghouse brake.—20th. Natural phenomena as causes of accident.—21st. Origin of individual accidents.—22d. Parts of the human economy most frequently injured.—23d. Conclusions.

CLASSIFICATION OF CAUSES—LAWS OF LIABILITY.

RAILWAY accidents may be classed under two general heads: 1st, catastrophes, where numbers of individuals are injured at the same time; 2d, individual accidents, where the individual alone suffers. Their causes may be divided into two general classes: 1st, defects in the normal operation of the railway, such as defects in road-bed and accessories, defects in motive power and rolling stock, defective construction, mental aberration, and negligence; 2d, acts of Providence, where natural phenomena operate with such suddenness as to debar the possibility of human anticipation, warning, or protection, such as washouts of road-bed, culverts, trestles, etc., by floods, water-spouts, etc.; and acts of individual malice. Individual accidents arise essentially from the same causes, in many cases, as catastrophes, but generally have for their basis imprudence, negligence, mental conditions or physical defects of the individual. Where the element of negligence in the administration of the railroad obtains, liability for injuries is accepted by the railway corporation, both for catastrophes and for injury to the individual. It is, and has been since 1846, a thoroughly established principle of law that when negligence exists, corporations[1] "are liable for past and future physical and mental suffering, together with the loss of earning power where the consequences are such as in the ordinary course of nature may be reasonably expected to ensue." The duty of a railway company to its employees has thus been defined: It is bound "to use all reasonable care and foresight, to provide safe structures, competent employees, approved appliances necessary to the safety of the employee, and to adopt and enforce such rules and regulations for running its trains as will avoid injury to its employees so far as this can be reasonably done." A railway company is legally bound to use reasonable care and judgment in the selection of ordinarily skilful and trustworthy servants, and is liable for the wrongful acts of its servants done while acting within the scope of their duties, although such acts were not only not authorized but positively forbidden. The company which, with a knowledge of the wantonly wrong conduct of its servant, maintains him in its employ, thereby ratifies his actions. An employee whose acts are such as to justify an award of punitive damages is guilty of conduct which calls for his dismissal from the service. The rule which requires the reasonable exercise of care in the selection of competent servants applies with equal force to their retention. Wanton recklessness may be established by showing gross want of care, skill, and judgment in furnishing suitable machinery, materials, and appliances, as well as in the selection of servants. Taking into consideration the enormous responsibility imposed upon railroads in the handling of trains, and the transportation of millions of people annually, it can be safely said that every endeavor upon their part is in the direction of safety, with the aim to render accidents infrequent by the most complete investigation and inspection, and their maintenance in proper condition of all materials used; by perfecting the physical condition of road-bed and accessories pertaining thereto; by care of motive power and rolling-stock; and by employing disciplined agents in the manipulation of its trains. But with almost perfect inspection, analysis, and study of materials used, erratic and unforeseen conditions may be engendered and become manifest in accidents.

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[1] Patterson on Railway Law.

MENTAL CONDITION OF EMPLOYEE—ALWAYS AN UNCERTAIN BUT POSITIVE CAUSATIVE FACTOR IN THE PRODUCTION OF ACCIDENTS AND CATASTROPHES.

For the selection of employees imperfect data only are attainable; hidden, and oftentimes masked, mental states cannot be discovered or made manifest by any means at man's command: it cannot be foretold at what moment a man's brain may act abnormally and cause a catastrophe. In general, aberrant mental conditions are of such nature that their occurrence cannot be foreseen and prevented. The gradual origin of pathological conditions incidental to the nature of employment, morbid conditions otherwise acquired, and the evolution of hereditary defects, are all operative in the possible production of anomalous mental states; hence it is utterly impossible to form a just judgment of mental conditions in all individuals at all times. Therefore, so long as human agents are necessary in the manipulation of railways, so long will the catastrophe be an attendant upon their management; and that too, in spite of the best discipline, and of the most perfect study and inspection of every factor entering into their equipment and manipulation.

ILLUSTRATIONS OF HETEROPHEMY AND AUTO-HYPNOSIS OCCURRING TO EMPLOYEES.

Thus, in illustration, take that mental condition which occurs among railway train-dispatchers and has caused many fatal accidents, called by Richard Grant White "Heterophemy," or thinking one thing while saying, hearing, or reading another.[1]

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[1] E. Alexander on "Railway Management," in Scribner's "American Railway," 1893, says: "A case within my knowledge which cost a dozen lives was as follows: Two opposing trains were out of time, and the train-dispatcher wished to have them meet and pass at a certain station we will call I., as No. 1 and No. 2. So he telegraphed the following message to be delivered to No. 1 at H. and No. 2 at J.: 'No. 1 and No. 2 will meet at I.' This message was correctly received at J. and delivered to No. 2, but at H. the operator had just sold a ticket to a pas-

This condition is not peculiar to the train-dispatcher, but is found among almost all other classes of employees. The work of the train-dispatcher, however, renders him especially obnoxious to it. Again, an "auto-hypnotic" condition is common among engineers, engendered in them in consequence of habits arising from the nature of their work. Familiarity with the road leads to concentration of gaze upon some particular part of engine or road, until a state resembling hypnosis is produced, in which unconscious cerebration is made manifest.[1] It is hardly necessary to enter into details regarding mental aberrations, since they simply indicate abnormal mental conditions of employees; nor to enumerate the many diseased conditions that may lead to mental trouble.

CAUSAL FACTORS OF THE CATASTROPHE.

In the production of a catastrophe it can rarely be said that but one factor has been operative; for, as a general thing, the disaster must be attributed to the combination of a variety of anomalous conditions, such as defective materials, defective mentality in employees, and dangerous physical surroundings.

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senger to K., and, getting this name in his head, he wrote out the message: 'Nos. 1 and 2 will meet at K.' But the mistake was not yet past correction. The operator had to repeat the message to the dispatcher that the latter might be sure that it was correctly understood. He repeated it as he had written it, 'K.'; but the dispatcher was also 'heterophemous.' He said 'K' but thought 'I,' and replied to the operator that the message was O.K.; so it was delivered to No. 1, and that train left H. at full speed to make thirty-five miles to K. before meeting No. 2. There was no telegraph office at I. and there were no passengers to get off or on, and it passed there without stopping, and three miles below ran into No. 2 on a curve. By one of those strange impulses which seem to come from somewhat unconscious cerebration, the train-dispatcher meanwhile had a feeling that something was wrong, and looked again at the message received from H. and discovered his mistake. But they were then out of reach; and he still hoped that No. 2 might arrive at I. first, or that they might meet upon a straight portion of the road; and as the time passed he waited at the instrument in a state of suspense which may be imagined. When the news came he left the office and never returned."

[1] Upon investigation I have found these conditions to exist: owing to the fact that an engineer is familiar with his road, knows certain stretches of track, and is habituated to the running of his engine, he gazes constantly on some portion of engine or track. It is the concentration of vision on limited area which is used by the neurologist to produce hypnosis. It is the concentration of vision with the engineer which begets similar conditions. Time and time again have I heard engineers' firemen detail stories plainly indicating unconscious cerebration in their superiors. Stories of erratic action during the time of accidents often point to the existence of this condition.

Thus, in illustration, take the Ashtabula catastrophe, which occurred at Ashtabula, Ohio, on the Lake Shore and Michigan Southern Railway, on the 29th of December, 1876. The contributing conditions were a bridge of faulty construction in the first place, built over a deep ravine—sixty-nine feet above bottom of ravine,—in which indications of weakness had been presented, but of which no notice had been taken; heavy snowdrifts; two locomotives attached to a train of eleven cars, one of which partly passed over, the other and nine coaches went to the bottom of the ravine; cars heated by stoves took fire; and contradictory orders were issued, to subdue the flames, in consequence of which the cars were consumed. More than half of the passengers were otherwise killed or allowed to be consumed by fire. Eighty persons were killed, and sixty others injured, costing the railroad company over six hundred thousand dollars.

CONDITIONS NECESSARY TO THE SAFE OPERATION OF THE RAILWAY.

It has been asserted with truth that nearly everything used on a railway has an economic or mechanical value, and that if it promotes safety it is but a part of its duty. "A great source of safety in railroad working is good discipline. Of all the train accidents which have happened in the United States in the last sixteen years nearly 10 per cent. were due to negligence in operation, and 17 per cent. were unexplained. Of these no doubt many were due to negligence, and many were attributed to defects of track and equipment which would have been prevented had men done their duty. The value of mechanical appliances for safety perhaps is as often over-rated as under-rated; undoubtedly the best, and in the long run the cheapest, practice will be that which combines in the highest degree both elements—disciplined intelligence, and perfection of mechanical detail."[1] At this juncture it will be fit and proper to individualize the essential elements constituting the railroad, and their causative power in producing accidents.

ROAD-BED AS A CAUSE IN PRODUCING ACCIDENT.

The road-bed, of course, constitutes the chief element of the railroad, and we find its various modes of construction depend-

[1] H. G. Prout, "Safety in Railroad Travel," in "The American Railway."

ing entirely upon the physical condition of the surface on which it is to be placed. All railway lines in the older countries were made as straight as possible, with easy grades and gentle curves; but in this country different conditions arose and were met; physical difficulties formed no barrier, and in proportion as difficulties were encountered, ingenuity seemed to be stimulated and always ready and competent to overcome them. First as to ballast, which is the means of preserving the integrity of the superincumbent track placed upon it, and as a general thing constitutes the chief factor of the railroad's safety. The ballast used depends upon the soil of the country where the road is constructed; in certain States, particularly some Southern States, sand ballast seems competent to make a safe and elastic road-bed. As a general thing, broken stone, macadam, slag, cinders, or gravel form the road-bed. Accidents may and do arise from this source, as from neglect to prevent a gradual impaction of ballast due to heavy weights above, which causes swinging joints and breakage of rail; or from freezing and subsequent thawing of the ballast with consequent softening of the earth beneath; or from excessive rain washing portions out, at times causing the track to sink, with interruption of its continuity. Cross-ties are now used upon most of the railways of America, and they are generally made of hard-wood, though in certain portions of the country softer woods answer—white oak, chestnut, locust, catalpa, and yellow pine. The base of the rail rests upon these cross-ties, and the number essential to constitute a good solid road-bed varies, depending upon their width and the physical condition of the soil, from 2,000 to 3,500 per mile. Thus, if the ties are laid with a separation of 18 inches from centre to centre, there will be 3,520 ties to the mile; with 30 inches from centre to centre, 2,113 to the mile. The integrity of the tie, of course, keeps the rails from spreading, as each rail is spiked into the tie. Under certain conditions where age produces decay or fire burns the wood the tracks spread and cause derailment of the train. Bessemer steel rails are now used upon all main tracks where speed is demanded and excessive weight carried. By actual test one steel rail has outworn seventeen iron rails, with only five-sixteenths of an inch worn off of its top. The average weight of the steel rails now used ranges from sixty to eighty-five pounds per yard. Under certain exceptional circumctive rails, switches and frogs, but bridge wrecks. There are, owever, few devices used in the tracks that can be called afety-appliances. Many so-called safety-switches and safety-rogs are offered to railway officials, but those actually in wide use comprise but a very few standard forms. The split-switch has gradually replaced the old stub-switch, as well as the so-called safety-switches that have been from time to time introduced, although the stub-switch is in considerable use in yards where movements are slow, and on the main tracks of the less progressive roads. It consists of a pair of moving rails the ends of which may be placed opposite to the ends of the main line rail or to those of the turn-out, as the need may require. It follows that but one of these tracks is continuous at any one time, and the train reaching the switch by the other track must be derailed. The distressing accident which happened at Rio, Wis., in 1866, when seventeen people lost their lives, was a derailment of this sort. Since that time the railroad on which it happened has taken out stub-switches on thousands of miles of main-line track. The split-switch provides against such derailment; for if the switch is set for the turn-out and a train approaches it from the main line in the 'trailing direction' the flanges of the wheel move the switch-rail to make the track continuous. The terms 'facing' and 'trailing' as applied to switches are almost self-explanatory—if a train approaches toward the points of the moving rails the switch is said to be 'facing;' if it runs to the switch from the rear of the moving rails, the switch is said to be 'trailing.'"

THE BRIDGE AS AN AGENT IN THE PRODUCTION OF CATASTROPHE.

Probably no factor as a cause of accident on railroads has been more immediately destructive of human life, attended with the most harrowing details, than the railroad bridge. While in the aggregate collisions cause one-third of the train accidents, and derailments more than one-half, and these are constantly more destructive to life and property, yet the bridge accident to passenger trains rarely fails to partake of the nature of a catastrophe, owing to the intensity of the forces at work—gravity which plays a profound part, and physical nature, which the bridge in its integrity conquers. It has been estimated that

stances a rail weighing as high as one hundred and twenty pounds per yard is used. Their average length is thirty feet. The weight which rails will carry without being injured depends somewhat upon their size or weight, but ordinarily from twelve to sixteen thousand pounds per wheel is about the greatest load which they should carry. Where rails are joined together, two iron or steel bars from eighteen to twenty-four inches long, called fish-plates, are bolted on both sides of the union. There are 352 complete joints per mile. Where the joint lies immediately above a cross-tie, it is called a "supported joint;" when the cross-ties come on each side of the joint, it is called a "suspended joint," and the latter is considered the best, as greater elasticity is imparted to the track, and there is less injury to the ends of the rails, thus preserving the virtue of the joints in a greater degree. The integrity of joints at times becomes involved, thus causing accident. The rail itself, of course, depends for its integrity upon a solid road-bed, which, as we have already indicated, in turn depends upon the solidity of the earth on which the ballast is placed; upon the strength of the ties, and upon the strength of the joints. Other conditions aside from these frequently involve the track (the rail). Extremes of temperature causing expansion and contraction of rail have been a cause of its fracture. Broken rails are very frequently the cause of derailment of trains, and oftentimes, where conditions are unfavorable, lead to a catastrophe. Thus, upon the Erie Railway, April 14th, 1876, a train made up of a locomotive, three baggage cars, and seven passenger cars, encountered a broken rail at Carr's Rock while rounding the curve and going at a high rate of speed. The outer side of the curve was a steep declivity of some eighty feet, "jagged with rocks and boulders."[1] The broken rail was safely passed over by all the cars except the last one, which was thrown off the track, and then dragged along for a short distance. The great strain then broke the coupling between the four rear cars and the head of the train. The last of the four being already over the embankment, the others were instantly toppled over after it, and rolled down the ravine. Twenty-four persons were killed and eighty injured. From no source do we have as many derailments as from broken rails, and that too in spite of studious care and pre-

[1] Adams on "Railway Accidents," G. P. Putnam's Son, N. Y., 1879.

vious investigation and close watching of the rail. The integrity of a rail cannot, as a general thing, be determined from its appearance. Age and use wear out even steel.

Curves of the Railway as a Cause of Accident.

In the growth of the railway in this country former precedent had to be ignored; the establishment of curves became an economic factor in their construction. While a tangent is always desirable, yet curves enabled impediments to be overcome and miles of road to be built which otherwise could not have been constructed. While curves on the railway are oftentimes points of essential danger and the cause of accident, owing to the fact that, as a rule, they occasion obscuration of vision which at times is conducive to collisions, not only with trains, but with land-slides and other impediments thrown on the track, they are likewise dangerous in consequence of the play of centrifugal force.

Elements Diminishing the Danger of Curves.

The swivelling truck placed above the front wheels of our locomotives and under cars overcomes many of the dangerous elements of curves; likewise, the equalizing beams or levers by which the weight of the engine is always borne by three or more driving-wheels. The latter "act like a three-legged stool which can always be set level on any irregular spot." Centrifugal force ceased to be the great element of danger when these improvements were devised, engines and cars passing around curves with impunity in consequence of the improvements indicated. There are on our main lines in this country curves with a radius of less than three hundred feet, while there are but few curves upon European railways having a radius of less than one thousand feet. On the Manhattan Elevated Railway, with the largest passenger traffic in the world, the road is conducted around curves with a radius of less than one hundred feet. Curves under certain conditions must necessarily always be dangerous, particularly owing to the liability to derailments on them arising from broken equipment, such as broken tires and flanges on engines, broken flanges on car-wheels, and broken rails.

DANGERS OF THE GRADIENT AS A CAUSE OF ACCIDENT—MODIFYING CAUSES.

The gradient of a railroad constitutes one of its economic factors. Steep grades curtail its earning capacity; and in earlier days they were a constant source of danger, especially over mountain roads, owing particularly to the liability to disruption of couplings and the incapacity of brakes, with consequent collisions and derailments. The discovery of the climbing capabilities of locomotives on smooth rails,[1] and the great improvement in brakes, particularly in the Westinghouse, with its continuous element, triple valve and automatic arrangement, affording reliable means of stopping trains upon steep grades, overcame one element of danger. Again the switch-back, with its zigzag arrangement for reducing grades, by means of which trains are made to go up and down in safety where otherwise the grade would be a constant menace to the passengers and the employees of the railway, has done its share in removing danger. In proportion to the natural danger of surroundings extra care is exercised, and it is rare indeed to have a serious accident in the present day from steep grades. Grades vary according to the region or physical phase of nature to be met. Upon the main line of our railroads they vary from five feet per mile to two hundred and eleven feet per mile. Thus trains go over 4 per cent. gradients in Colorado.

It has been computed that 13 per cent. of the train accidents in the United States in the last sixteen years were derailments due to defects of road. Good material, good workmanship, and unceasing care are absolutely necessary for the proper working of a railroad.

SWITCHES AS A CAUSE OF ACCIDENT—VIRTUES OF SPLIT-SWITCH AND STUB-SWITCH.

Another element productive of accidents has been the switches. Although the number of accidents caused by switches has not been very great, still their effects at times have been serious and undoubted. H. G. Prout, speaking concerning the accident from derailment, says: "These include not only defective rails, switches and frogs, but bridge wrecks. There are, however, few devices used in the tracks that can be called safety-appliances. Many so-called safety-switches and safety-frogs are offered to railway officials, but those actually in wide use comprise but a very few standard forms. The split-switch has gradually replaced the old stub-switch, as well as the so-called safety-switches that have been from time to time introduced, although the stub-switch is in considerable use in yards where movements are slow, and on the main tracks of the less progressive roads. It consists of a pair of moving rails the ends of which may be placed opposite to the ends of the main line rail or to those of the turn-out, as the need may require. It follows that but one of these tracks is continuous at any one time, and the train reaching the switch by the other track must be derailed. The distressing accident which happened at Rio, Wis., in 1866, when seventeen people lost their lives, was a derailment of this sort. Since that time the railroad on which it happened has taken out stub-switches on thousands of miles of main-line track. The split-switch provides against such derailment; for if the switch is set for the turn-out and a train approaches it from the main line in the 'trailing direction' the flanges of the wheel move the switch-rail to make the track continuous. The terms 'facing' and 'trailing' as applied to switches are almost self-explanatory—if a train approaches toward the points of the moving rails the switch is said to be 'facing;' if it runs to the switch from the rear of the moving rails, the switch is said to be 'trailing.'"

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[1] B. H. Latrobe, Chief-Engineer Baltimore and Ohio Railway, discovered this in 1852.

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there are now in the United States nearly 220,000 bridges of all kinds.[1] Competent authorities claim that the wooden bridge and trestles enabled this country to build 150,000 miles of railway; and that America adopted the invention of Leonardo da Vinci, and made practical the ideas of the seventh century in the more progressive nineteenth century. The first wooden truss bridge was a product of American invention, and, as claimed by Clarke, Burr and Wernburg, two Pennsylvania carpenters, were its originators. A bridge built by Wernburg across the Delaware River in 1803 was used as a highway bridge for forty-five years; it was then strengthened and used as a railway bridge for twenty-seven more, when a new structure replaced it. C. Whipple, civil engineer, made the first attempt to solve the mathematical problem upon which the due proportions of the iron bridge depends. The Howe truss bridge is constantly used on Western roads, to be ultimately replaced by iron or steel. The introduction of mild steel in bridge-building made greater advances and more perfect construction possible. It is claimed that steel has an ultimate strength of from sixty-three to sixty-five thousand pounds per square inch, or 40 per cent. more than iron. And it is tough enough to be tied in a knot or punched into the shape of a bowl while cold. With this material it is as easy to construct spans of five hundred feet, as it was to build spans of two hundred and fifty feet in iron. Bridges are now designed to carry much heavier loads than formerly. The best practice adopts riveted connections, where pins and eyes are still very properly used. Plate girders below the track are preferred up to a length of sixty or seventy-five feet, then riveted lattice up to one hundred and twenty-five feet. It is hardly necessary for us to enter into detail regarding the various improvements in bridge construction. The wonders, strength, and effectiveness of the cantilever bridge have been demonstrated beyond question. The successful erection of the Niagara fective rails, switches and frogs, but bridge wrecks. There are, however, few devices used in the tracks that can be called safety-appliances. Many so-called safety-switches and safety-frogs are offered to railway officials, but those actually in wide use comprise but a very few standard forms. The split-switch has gradually replaced the old stub-switch, as well as the so-called safety-switches that have been from time to time introduced, although the stub-switch is in considerable use in yards where movements are slow, and on the main tracks of the less progressive roads. It consists of a pair of moving rails the ends of which may be placed opposite to the ends of the main line rail or to those of the turn-out, as the need may require. It follows that but one of these tracks is continuous at any one time, and the train reaching the switch by the other track must be derailed. The distressing accident which happened at Rio, Wis., in 1866, when seventeen people lost their lives, was a derailment of this sort. Since that time the railroad on which it happened has taken out stub-switches on thousands of miles of main-line track. The split-switch provides against such derailment; for if the switch is set for the turn-out and a train approaches it from the main line in the 'trailing direction' the flanges of the wheel move the switch-rail to make the track continuous. The terms 'facing' and 'trailing' as applied to switches are almost self-explanatory—if a train approaches toward the points of the moving rails the switch is said to be 'facing;' if it runs to the switch from the rear of the moving rails, the switch is said to be 'trailing.' "

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[1] Iron and wood truss bridges in the year 1888 numbered 61,562 feet span, 1,086 miles; wooden trestles 147,187 feet span, 2,127 miles; total 208,749 feet span, 32,013 miles.

Probably three-fourths of the truss bridges are now of iron or steel, and may be considered perfectly safe so long as the train remains upon the rail, and does not strike the side of the trestle. The wooden trestles are a constant source of danger, producing injuries from derailed trains and should be replaced by permanent structures as time and money will allow.—Thomas Curtis Clarke in "The American Railway."

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CHAPTER I.

CAUSATIVE FACTORS PRODUCING RAILWAY INJURIES.

1st. Classification of causes.—Laws of liability.—2d. Mental conditions of employee.—Always an uncertain but positive causative factor in the production of accidents and catastrophes.—3d. Illustrations of heterophemy and auto-hypnosis occurring to employees.—4th. Causal factors of the catastrophes.—5th. Conditions necessary for the safe operation of the railway.—6th. Road-bed as a cause of accident.—7th. Curves of the railway as a cause of accident.—8th. Conditions diminishing the danger of curves.—9th. Dangers of the gradient as a cause of accident, modifying causes.—10th. Switches as a cause of accident—Virtues of the split-switch and stub-switch.—11th. The bridge as a cause of catastrophes.—12th. The small trestle or bridge more fruitful in accidents than the larger structures.—13th. Bridge accidents commented upon.—14th. Manipulation of trains as a cause of accident.—15th. Negligence of employees, and disease and overwork as causes.—16th. The rules of train-dispatching, if rigidly followed, a prevention of accident.—17th. Signals—The semaphore and the interlocking switch considered.—18th. Causes due to defective motive power.—19th. Inspection of trains.—Miller platform.—Westinghouse brake.—20th. Natural phenomena as causes of accident.—21st. Origin of individual accidents.—22d. Parts of the human economy most frequently injured.—23d. Conclusions.

CLASSIFICATION OF CAUSES—LAWS OF LIABILITY.

RAILWAY accidents may be classed under two general heads: 1st, catastrophes, where numbers of individuals are injured at the same time; 2d, individual accidents, where the individual alone suffers. Their causes may be divided into two general classes: 1st, defects in the normal operation of the railway, such as defects in road-bed and accessories, defects in motive power and rolling stock, defective construction, mental aberration, and negligence; 2d, acts of Providence, where natural phenomena operate with such suddenness as to debar the possibility of human anticipation, warning, or protection, such as washouts of road-bed, culverts, trestles, etc., by floods, water-spouts, etc.; and acts of individual malice. Individual accidents arise essentially from the same causes, in many cases, as catastrophes, but generally have for their basis imprudence, negligence, mental conditions or physical defects of the individual. Where the element of negligence in the administration of the railroad obtains, liability for injuries is accepted by the railway corporation, both for catastrophes and for injury to the individual. It is, and has been since 1846, a thoroughly established principle of law that when negligence exists, corporations[1] "are liable for past and future physical and mental suffering, together with the loss of earning power where the consequences are such as in the ordinary course of nature may be reasonably expected to ensue." The duty of a railway company to its employees has thus been defined: It is bound "to use all reasonable care and foresight, to provide safe structures, competent employees, approved appliances necessary to the safety of the employee, and to adopt and enforce such rules and regulations for running its trains as will avoid injury to its employees so far as this can be reasonably done." A railway company is legally bound to use reasonable care and judgment in the selection of ordinarily skilful and trustworthy servants, and is liable for the wrongful acts of its servants done while acting within the scope of their duties, although such acts were not only not authorized but positively forbidden. The company which, with a knowledge of the wantonly wrong conduct of its servant, maintains him in its employ, thereby ratifies his actions. An employee whose acts are such as to justify an award of punitive damages is guilty of conduct which calls for his dismissal from the service. The rule which requires the reasonable exercise of care in the selection of competent servants applies with equal force to their retention. Wanton recklessness may be established by showing gross want of care, skill, and judgment in furnishing suitable machinery, materials, and appliances, as well as in the selection of servants. Taking into consideration the enormous responsibility imposed upon railroads in the handling of trains, and the transportation of millions of people annually, it can be safely said that every endeavor upon their part is in the direction of safety, with the aim to render accidents infrequent by the most complete investigation and inspection, and their maintenance in proper condition of all materials used; by perfecting the physical condition any acquired, inherited, or predisposing disease, to various anomalous mental conditions. It is a noted fact that, with all the extra care and precaution in the repetition of messages received, and the duplicates furnished officials and employees, peculiar mental conditions are constantly liable to crop out; notably the one which we have previously referred to, "heterophemy," which, as has been shown before, has been the occasion more than once of producing a catastrophe with consequent loss of life. Oftentimes incorrect orders are transmitted by the train-dispatcher in consequence of excessive exertion and lack of rest; at times his error is as much his own fault as that of the officials. Neglect and disobedience of train crews, in not paying due attention to explicit rules conspicuously placed in every position where memory can be refreshed, are responsible for accidents.

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[1] Patterson on Railway Law.

NEGLIGENCE OF EMPLOYEES AND DISEASE AND OVER-WORK AS CAUSES.

Irregular and rapid running upon the part of heavy, large, and imperfectly equipped freight trains; imperfect brakes; bad order of cars, at times causing the breaking in two of trains, are fruitful causes of accident. The disobedience of orders to clear the siding; mistakes in time, notwithstanding the rule for train-men to compare watches, and to allow five minutes for mistakes at meeting-points; incorrect reading of orders upon the part of engineers and conductors, due in many instances to mental conditions allied to heterophemy, and at times to those incidental to intemperance—often occasion disaster. Many errors arising from mental conditions bring about dangerous positions, and, according to circumstances, may produce personal injury or death. To enter into a full consideration of the causes pertaining to mental conditions which are at the basis of many accidents would be to give a history of diseased conditions; and any endeavor to analyze these mental conditions would require more space than is at present available. Accidents not infrequently arise in consequence of poor official judgment, where operatives of trains are compelled by the arrangement of schedules to work beyond their physical endurance; and this is particularly so in the warmer seasons of the year. It is immaterial whether this arise from the willingness of the employees to undergo undue physical effort, or whether they are compelled by officials to work beyond their physical endurance.[1] It can be shown that, where employees are compelled to stand excessive tests upon their physical powers, accident is a constant attendant upon their work, especially owing to their sleeping while on duty. Lack of discipline, neglect, disobedience, and wanton wilfulness seem, as a rule, more productive of catastrophes than do defects of materials.

THE RULES OF TRAIN-DISPATCHING, IF RIGIDLY FOLLOWED, A PREVENTIVE OF ACCIDENT.

The general principle of train-dispatching, if duly observed, will prevent collisions; but never-ceasing care and strict discipline constitute at all times the greatest element of safety in railway management.[2] The present code of rules by which trains are manipulated, and the signals now generally used in this country, have been formulated by committees and approved by national railway conventions.

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[1] Overwork on railways is highly dangerous, both to servants and passenger. Ten hours a day of railway work, considering its importance, should be sufficient; and care should be taken that proper time for rest, say eight or nine hours, is allowed between each term of duty. Signalmen should not be called upon to work more than eight hours continuously; and at very busy and large junctions, six hours is as much as should be required. It is not a question of how many hours a man can work, but of how many hours he can work efficiently and safely; and any railway servant who has been on duty fifteen, eighteen, or twenty-four hours, is not and cannot be in a fit condition to devote that sole attention to his work which its importance so much demands.

Major Marindin reported to the Board of Trade: "It is not difficult to account for the conduct of these men, who, I feel convinced, must have been asleep, or nearly so, upon the engine; for they had at the time been on duty for nearly sixteen and a half hours. It hardly needed this accident to show the enormous risk which attaches to the employment of drivers for these inordinately long hours; for it has often been pointed out in previous similar cases; and apart from this it should be patent to all that there is a limit to human endurance, and that a driver cannot be considered to be in a fit and proper state to perform his very responsible duties after working for such a length of time."—"Safe Railway Working," by C. E. Stretton, C.E. Pub. by Crosby, Lockwood & Son, London.

[2] First, all freight trains must wait indefinitely for all passenger trains. First and most important, no train must ever under any circumstances run ahead of time; next, any train making a stop not in its schedule must immediately send out a flagman with a red flag during the day, and a red light and torpedoes at night, to protect. Now when a train is prevented from arriving on time at its meeting-point there must be some rules by which the opposing train may proceed, or all business on the road would be suspended by the delay of a single train. Only the general principle of these rules can be stated within limits. They are as follows: First, all freight trains must wait indefinitely for all passenger trains. Secondly, where one train only is behind time, the opposing train of the same class will wait for it the specified time, usually ten minutes, and five minutes more for possible variation in time, then go ahead, keeping fifteen minutes behind its schedule. Thirdly, should a train running on delayed

Signals—The Semaphore and the Interlocking Switch Considered.

In preventing accident, timely information of the need to stop trains, which is conveyed by signals used to protect points of danger, to govern the movements of engines in yards, and to keep an interval of space between two trains running on one track, is of the greatest importance. The semaphore signal[1] has become a standard in this country. In yards there is an arrangement of signals and switches in such a way that their movements are made mutually dependent, as exemplified in the interlocking of switches. Interlocking has become a special science and has made it possible to concentrate levers which move switches and signals into one place and under one management. It is a mechanical impossibility for a signal-man to give a signal which would lead to a collision or derailment within the region under the control of the interlocking station. These devices come mainly within the scope of local detection in the manipulation of cars, the arrangement of trains, and in switching for various purposes. Yard accidents are very frequent and indi-

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time lose more time, or in any way should both trains get behind time, then the one which is bound in a certain direction, for instance north, has the right to the track, and the other must lie indefinitely.

[1] This consists of a board, called the blade or arm, pivoted on the post, and back of the pivot is a heavy casting which carries a colored glass lens, either green or red, on the post-hanging lantern. The danger position is with the blade horizontal. In this position the lens is on the point of the lamp, and the light shows red or green as the case may be. The safety position is with the blade hanging about sixty degrees from the horizontal. In this position the light of the lantern shows white. Red is the universal color for danger, and green the color for caution. Therefore a semaphore signal at a point of danger shows by day a blade painted red with the end of the blade cut square. At night it shows a red light at a position some distance from the point of actual danger; but when it is desirable to warn an engineer that he is likely to find danger ahead, a cautionary signal is placed. This is a semaphore blade painted green with the end notched in a V-shape, called a fish-tail. At night this signal shows a green light. There is nothing very remarkable about a piece of board so arranged as to wag up and down on a pin stuck through a post, but it is wonderful how much of good brains and good breath have been expended in getting these boards to wag harmoniously, and to get railway officers to understand that a plain board having two possible positions is a better signal than any more complicated form.—*Prout. Loc. cit.*

vidually severe, consequently presenting fatal features, more so in proportion to the number of men employed than almost any other position in railroad service. Coupling accidents are exceedingly common, owing to the various forms and sizes of car couplers, broken couplers, and "bad order" cars. There has been a constant effort upon the part of the management of railways to eliminate the element of human agency whenever and wherever it can be done with safety. In spite of the existing rules, which, if rigidly followed, would be preventive of accidents, owing either to a lack of discipline or mental conditions accidents are of constant occurrence, and hence the effort to introduce the block-system. But, as previously mentioned, it has been found that even an absolute block-system, as at present devised, is defective as a protection against rear-end collisions; and it is a common matter of observation that where human agency is depended upon the rear-end collision will be of frequent occurrence. From statistics obtained from various sources, it has been computed that in 1892 there were 231 rear-end collisions, and about one-half of these were instances where a freight train ran into the forward train. There was only one employee killed and two wounded, while we find 23 passengers killed and 132 wounded, in the rear-end collisions, obviously for the reason that employees were generally competent to see the impending danger and seek safety, while the passengers most frequently met it unawares.

CAUSES DUE TO DEFECTIVE MOTIVE POWER.

Having thus far considered the cause of injuries arising on railways mainly in connection with the road's integrity and the manipulation of its trains, it is but natural to pass to the consideration of some of the causes due to defective motive power and rolling-stock. The locomotive was the real incentive and cause of the railroad, and in proportion to its power in its normal condition is the most amenable piece of machinery ever devised by man; but under adverse conditions it is competent to create the most appalling catastrophes. In its construction, its every element is tested from its start to its completion, and that under skilled supervision; when in operation, a studied care eternally surrounds it. While the breakages of its parts are numerous, it is indeed rare to have any very serious accidents follow in consequence. Its axles may break; its driving tires, its flanges may break; its side-rods may snap and dismantle the cab and injure fireman or engineer. Explosion of its boiler is so infrequent as to be a surprise; and, as a rule, its accidents are more dangerous to the engineer and fireman than to any one else. This is mainly dependent upon the Westinghouse automatic brake. It is by this brake that the engineer has time and time again prevented collisions, and saved not only his own life but the lives of others.

Defects in rolling-stock are a cause of accident, and at times lead to positive catastrophes, depending of course upon the position and condition of the track where the accident occurs. Not infrequently there is breakage of axles of cars, or a bent axle may be followed by disaster, as in the Angola horror; broken flanges, broken brakes, and defective couplings are a constant source of accident.

INSPECTION OF TRAINS—MILLER PLATFORM—WESTINGHOUSE BRAKE.

Constant inspection of all wheels, particularly of passenger coaches, at stated points along the line, is demanded and constantly enforced. All parts of a passenger train are thoroughly inspected before leaving, and its inspection is continuous to the termination of the journey. Rewards are offered and paid for finding defects. The modern passenger train certainly combines in the most exalted degree results of the most careful study. Of these perhaps the Westinghouse automatic brake is the most remarkable. It has the marvellous capacity of stopping trains of cars one-third of a mile long, going at the rate of speed of forty miles an hour, smoothly, without jolt or jar, in one-third of its own length. This brake has been the cause of preventing more catastrophes that would have resulted from collisions and derailments than any device ever placed upon a railroad; and as a life-saving factor no device equals it. Indeed no one praises its virtues more than the engineer whose daily contact with it makes him pronounce it, beyond all comparison, absolutely the most perfect safety device for himself and those whom he carries under the guidance of the locomotive. The Miller platform and coupler is another device which has saved many myriads of lives. And now the vestibule has been added, which enables the perfect ventilation of crowded trains, and debars the possibility of falling off trains while in motion. This new device will undoubtedly prove a most potent factor in preventing the production of that comparatively frequent trouble known as "traumatic neurosis." It has already been demonstrated that by its great springs it diminishes the dangerous element of concussion attendant upon collisions, by neutralizing the shock of propelling forces; and it prevents the possibility of telescoping.[1]

NATURAL PHENOMENA AS A CAUSE OF ACCIDENT.

We will not attempt to enter into details regarding accidents where natural phenomena act with such suddenness as to debar the possibility of human anticipation or protection; where, oftentimes, in spite of the closest attention to every detail and almost perfect discipline, serious accidents occur in consequence of abnormal and unforeseen conditions that suddenly arise. Where trains move over wide and unprotected spaces with rapidity; where physical conditions of a country are developed at times into abnormal conditions; where, in mountainous regions, there is possibility of land-slides, or that large trees or large stones may topple over on the track directly in front of trains, there may be no opportunity to avoid accidents. Waterspouts, and floods creating washouts, while trains are in transit between stations, are beyond the power of human anticipation. Thus varying extents of tracks, trestles, culverts, or even bridges may be suddenly destroyed. We recall many instances of this nature, particularly one where a culvert was washed out not more than ten minutes after inspection, and the next train was ditched, killing some four persons and injuring thirteen more. Again, where physical conditions seem to present every element of safety, disasters of this nature will sometimes occur. Thus we have seen three hundred feet or more of railroad track, built upon solid rock, washed out in but a few moments, derailing the engine, overturning cars, and killing three persons and injuring fifteen more.

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[1] The vestibule was devised as a safety appliance for the protection of human life in case of collisions. General Horace Porter, of the Pullman Palace Car Company, thus speaks of it: "It consists of frictional buffers or frame plates, practically the height of the car and projecting normally beyond the ends of the car and supported by the buffer springs below, and re-enforced by powerful springs at the top of the car. These frames are connected with the car at the sides by elastic diaphragms. When two cars are brought together and coupled the faces are the bearing surfaces of the steel frames which are pressed by the springs against each other, and the friction thereby created is sufficient to hold them permanently in position and to prevent the oscillation of cars. There is thus furnished a substantial buffer extending from the platform to the roof, which precludes the possibility of one platform riding the other, and producing telescoping in case of collisions. Authentic records show that in about a dozen instances in which such trains have been in collision at a rate of speed even as high as fifty miles an hour, the buffer plates and springs have taken up and distributed the shock through their spring resiliency, and prevented crushing or destruction of any portion of the car-bodies. In no instance has any passenger been seriously injured, and the cars have escaped with only trifling damage. In one of the worst of these collisions a passenger was standing in the vestibule and suffered no injury whatever. These escapes without loss of limb or life to passengers and with trifling expense to the railway companies have attracted marked attention. The friction upon the frame brakes is sufficient to prevent the oscillation or swaying of the cars from side to side, and adds largely to the general steadiness of the train when in motion. This has had a decided effect in preventing nausea from which so many passengers suffer in trains running at high speed over reverse curves. While the primary object of the vestibule was to create a safe and convenient passageway between the cars, the perfecting of the device has resulted in a safety appliance of inestimable value.

Origin of Individual Accidents.

The origin of accidents to the single individual is varied. They constitute an essential part of the accidents occurring upon railways, since they outnumber in the multiplicity of injuries thus done those inflicted in accidents where many persons are simultaneously injured. Their history is a record of poor judgment, negligence, disobedience of orders, criminal conduct, anomalous mental conditions, and absolute folly. The writer has tabulated 21,939 accidents from the reports of local surgeons and hospital records during the past sixteen years, many of which were under his personal observation. Thus knowledge has been gained which is not predicated upon theory but demonstrated by fact. Out of the number mentioned, 18,885 employees, 844 passengers, and 2,210 non-employees, or trespassers, were injured. Of these 18,885 injuries, 3,559 were to brakemen and 1,396 to yardmen. But 630 engineers were injured as compared with 1,184 firemen. Since they both occupy the engine cab it would be a pertinent inquiry why more firemen were injured than engineers. As a rule, the engineer sticks to his seat-box; the fireman passes backward and forward between cab and engine, thus making use of unstable footing, and placing himself in the power of gravity. By the manipulation of coal the fireman frequently has his fingers and hands damaged. It is quite uniform to find more than double the number of firemen injured in the transportation department as engineers, but usually the engineer's injuries are of a more fatal character than the fireman's. It will be noticed that we take only those in the transportation department of the railroad in illustrating the form of injury, as they are more exposed, and will suffice to show the general character of the individual accidents.

The employees are mainly injured under the following circumstances: Coupling and uncoupling cars, where there is lack of unformity in the various couplers used at the present time, and haste, indiscretion, or rapidity in execution, engender accident (3,446 injuries). Jumping off trains in motion caused 939; falling off trains in motion, 826 injuries. In the latter category it would be instructive and interesting if we could determine exactly the part played by uncertain footing while on top of box cars; the influence of gravity, the jolt, the jar, the miscalculation of stepping from car to car; and last though not least, the influence of intoxicants. No doubt many of these accidents occur in consequence of the individuals being intoxicated at the time. This is particularly true in the far West of the United States, where rash, intemperate, and otherwise immoral men are freely employed. Derailment of cars and engines caused 626 injuries; collisions, 447; boarding moving trains, 493.

Among passengers we find that 167 were injured by derailments, and 187 in collisions; 64 fell off moving trains. Doubtless, in a large proportion of the latter number intemperance played a *rôle*, and the vestibule would have prevented many jumping off moving trains; 82 persons were thus injured and 5 walked off trains while asleep.

Of the trespassers, or non-employees, we find that 728 were injured while walking on the track; 308 in attempting to board trains. These belong in many instances to the class called "tramps." Falling and jumping off trains—doubtless a goodly number were thrown off—caused 267 injuries. In 170 instances the individuals, with that lack of judgment induced by alcohol, were found drunk on the track; 82 persons had the poor judgment to go to sleep on the track; 63 found no better place to rest themselves than the rail; and 6 persons threw themselves in front of trains, plainly desiring to commit suicide.

PARTS OF THE HUMAN ECONOMY MOST FREQUENTLY INJURED.

It may not be uninteresing to specify the particular portions of the human economy that suffer most in consequence of injuries inflicted on railways. It comes very near being a general law that parts most frequently brought in contact with dangerous surroundings are most frequently injured. Thus, the upper extremity, from tip of fingers to clavicle, sustained 8,509 injuries, the fingers sustaining the greater number of injuries of any part of the economy in consequence of their number and multiform use (4,039 fingers crushed, contused, or fractured). The lower extremity received 5,609 injuries. There were inflicted upon the head and face 2,115 injuries; while the body received but 1,235 injuries. Sprains of all kinds and characters are of frequent occurrence, and they numbered 2,844; the ankle-joint receiving sprains to the number of 1,205, the most frequently sprained joint in the body. The lower extremity seems particularly exposed to fractures and sprains; the upper extremity predisposed to dislocations. Thus, 131 dislocations occurred to this part, while the lower extremity sustained only 30 dislocations. The tibia and fibula, or, better expressed, the legs, are the most frequently fractured parts of the economy; naturally so, in consequence of their frequent exposure and the union of force and gravity, as in jumping on and off trains, etc.

CONCLUSIONS.

While realizing that this portion of the subject is presented more in an historical than a medical light, we believe that it has an important medical bearing. The close study of causes in railway accidents certainly imparts greater scope of knowledge, not only clinically, but in a protective way. The study of the general characteristics of an agent capable of inflicting injury to the human economy not only saves the surgeon from the contumely of an incorrect prognosis, but it is an intelligent aid in treatment, and a positive defence against future adverse criticism or a suit for malpractice. Everything in connection with these injuries should be examined. The same painstaking study of details which leads the specialist to nicety of results is pre-eminently needed in railway injuries. The inspection of the apparel worn by the individual at the time of the injury has saved the writer from the contumely of an erroneous prognosis more than once. A shoe worn by the person at the time of an accident has told the extent of force and compression exerted on the injured member far better than the condition of the part injured. Thus, in railway injuries the inflicting agent should be studied with every other detail, including the possible mental element; for results oftentimes hinge upon the proper interpretation of all these factors.

It can be said with truth that in general the lawyer and the physician confine themselves too closely to the limits of their respective vocations; that is, the lawyer, while very profound in law, is usually very superficial in medicine; the physician, preeminently learned and practical in medicine, is ordinarily "nil" as to his knowledge of the law. While the extent of both law and medicine is ample excuse for the lawyer's ignorance of medicine and the physician's scant knowlege of the law, still the fact remains that there is a necessity for each of these professions to enlarge its knowledge in the field of the other.

In medicine a personal injury is studied with reference to cause as influencing its course and result; in law its cause is studied with respect to the question of liability. The lawyer seeks to solve the question of negligence as a causative factor, and to determine the extent of mental anguish and physical pain, the result as regards extent and permanency and loss of earning power. Negligence is the gist of every action for damages for personal injury, and when shown to exist authorizes a recovery, except when the negligence of the injured person contributed to the injury. To create a liability, negligence and a resultant injury must be shown. The mere concurrence of accident and injury does not show negligence, but an injury caused by negligent acts or omissions creates a liability for damage. The relation of cause and effect should be so intimate that the influence of the alleged causative act or omission should predominate over every other influence, and be in itself an efficient cause of injury. The study of causes in personal injury upon railways is of equal importance to both professions; aiding the surgeon by giving him a broader view of inflicting agents, and the lawyer by enabling him to form judgments based upon common sense and fact. In conditions engendered by railway accidents, the extent of suffering, mental and physical, the permanency of injury and all attendant adverse conditions, can only be determined by the experienced physician; and he can but ill perform his duty when he fails to take proper cognizance of the causes and effects of railway injuries in general and in particular.

CHAPTER II.

GENERAL DIVISION AND CONSIDERATION OF RAILWAY INJURIES.

1st. Railway injuries generally considered.—2d. Intensity of conditions creating railway injuries.—3d. Psychic shock, less upon the employee than the passenger.—4th. Tabulated list of character of injury generally occurring to passenger.—5th. Variety of wounds arising from derailments and collisions.—6th. Injuries to thorax, its walls, and contents.—7th. Injuries to the digestive apparatus, with a consideration of entasis.—8th. An analysis of entasis.—9th. So-called concussion of brain: immediate and ultimate effects.—10. Amputations considered.—11th. Frequent combinations of psychic and physical shock—Their effects, and illustration of extremes.—12th. Intensity and complications of compound fractures in railway injuries.—13th. Injuries to the back—Difference of effects and results—Difference between passengers and employees of railway.—14th. Frequency of back injuries occurring in railway injuries.—15th. A fuller consideration of back injuries where objective symptoms are partially lacking. —16th. Why psychic and physical conditions are lessened in the employee.—17th. A sprained back generally different in passenger and employee.—18th. Intensity of injury, as a general thing, means intensity of symptoms.—19th. Sprains of the back—Traumatic lumbago. —20th. Different regions of the back involved in sprains.—21st. Symptoms of traumatic lumbago.—22d. Illustration of lumbar sprain. —23d. Direct and competent force in concussion.—24th. Competent and positive force generally necessary to produce concussion of the spinal cord.—25th. Influence of race and occupation in the production of functional trouble.—26th. Relative frequency of spinal meningitis in back sprains.—27th. Infrequency of chronic spinal meningitis.—28th. Infrequency of spinal cord degeneration in back sprains. —29th. Some other causes in the production of these troubles.—30th. Hæmaturia arising from back injuries.—31st. Position of kidneys a predisposing cause of injury.—32d. General causation of hæmaturia. —33d. Means of diagnosing hæmaturia.—34th. Prognosis regarding ultimate effects of hæmaturia upon the kidneys.—35th. Illustration of ultimate effects produced by traumatism.—36th. Medico-legal consideration of hæmaturia producing albuminuria.—37th. Infrequency of ulterior results.—38th. Conclusions.

IN the examination, by the expert, of personal injuries resulting from railway accidents, it is necessary to determine whether the lesion under consideration is of a surgical nature, or secondary and consequent upon the trauma produced. Where we have direct mechanical solutions of continuity, under ordinary circumstances their interpretation involves a study of the normal effort at repair.

We do not refer here to injuries presenting purely functional manifestation, traumatic in origin, having no known organic basis, ill defined, irregular, varied in outline, and placed under the term of traumatic neurosis. Medico-legally, traumatic neuroses are of unusual interest in relation to railway injuries, not alone in consequence of their formerly being considered *sui generis* with the railways, but also in consequence of their frequent occurrence upon the same, their subjective nature and the baleful consequences developing in their history; their tendency to simulation, exaggeration, malingering; and the frequent litigation they cause.

As indicated before, plainly evident lesions of a surgical nature, where loss of parts, permanent disability, and deformity enter into the result, rarely need the interpretation of the expert. It would require more than ordinary ignorance in their investigation, a denseness and prejudice not ordinarily found in our legal surroundings, not to arrive at a comparatively just conclusion.

Still, questions of a surgical character may arise as to results obtained in given cases, as in amputations and compound fractures; for here extremes are constantly met. While, generally, indications are usually plain, yet the same general rule indiscriminately applied cannot be maintained regarding amputations. Secondary conditions, necessitating amputations, generally minimize adverse elements; but where there is excessive shock, extreme destruction of tissue and adverse physical effects are produced, as in crushed limbs, where ponderous and rapidly revolving wheels of locomotives and cars pass over the parts, twisting and affecting skin and other tissues far beyond the original seat of injury, the conditions debar the possibility of obtaining the same good results that are common in secondary amputations. Under such circumstances the indications are thoroughly clouded. The tissues are stretched and twisted, particularly the skin, though it may present no material difference of appearance from the surrounding cutaneous surface. The possibility of such devitalized tissues being used for purposes of repair is always to be kept in mind when determining the parts to be utilized for flaps. Thus it will be seen that adverse conditions in amputations, particularly in railway injuries, present problems for interpretation not always easily solved. The same may be said regarding many compound fractures occurring upon railways, where bones are extensively comminuted, and the excessive shock received at the infliction of the injury lowers the normal standard of nerve tone so as to produce an obtunded and halting recuperative power in the part of the system damaged. The compound fracture without attendant elements of shock, comminution of bone, and with slight injury to tissues, *cæteris paribus*, means rapid repair and a minimum amount of deformity, where intelligent and competent treatment has been followed. Shock, comminution of bone, and destruction of tissue mean just so much loss of tissue; and the adaptation of nature to this loss, and its reparation, results, as a general thing, in deformity more or less pronounced.

It is in the field of subjective troubles especially that the expert in railway injuries will meet the brunt of cases to elucidate; where he will have to unravel hearsay evidence and determine the truth regarding functional diseases. In such cases objective evidence is generally wanting. Here the expert must group symptoms and interpret their value—a task requiring more than ordinary ability, close observation, and a great deal of patience, study, and the exercise of unprejudiced and cool judgment. It will be found in experience that many functional troubles depend greatly upon the circumstances in which injured persons are placed.

Thus, in illustration, take the same number of injuries occurring to passengers upon a railway and those occurring to the employees of the railway. It will be found that, even though their character is the same, injuries to passengers present graver conditions than do the injuries to the employees. In many instances this is accounted for upon the basis of their physical difference; but again it is probably due, in many instances, to natural exaggeration and simulation of symptoms predicated upon the liability for damage of the railway as common carriers. It is but natural to find that the gravity of many injuries occurring upon the railway will be dependent upon existing condition of persons, intensity of the applied force, and the surrounding elements of danger and harm; but oftentimes the reverse exists. Where physical and psychic shocks are combined, the fullest intensity of traumatism is effected, even to collapse and death; and it is rare indeed to find them act mildly, producing under certain conditions psychoses, and ultimately gradually leading to progressive paresis, and even graver lesions of an undoubted character.

INTENSITY OF CONDITIONS CREATING RAILWAY INJURIES.

Page says: "The incidents indeed of almost every railway collision are quite sufficient, even if no bodily injury is inflicted, to produce a very serious effect upon the mind, and to be the means of bringing about a state of collapse from fright, and from fright only." "The suddenness of the accident, which comes without warning, or with a warning which only reveals the utter helplessness of the traveller; the loud noise, the hopeless confusion, the cries of those who are injured—these in themselves, and more especially if they occur at night or in the dark, are purely adequate to produce a profound impression upon the nervous system; and, even if they cause no marked shock or collapse at the time, to induce a series of nervous disturbances at no distant date." Page quotes Furneau Jordean,[1] who says: "The principal feature in railway injuries is the combination of the psychical and corporeal elements in the causation of shock in such a manner that the former, or psychical element, is always present in its most intense and violent form. The incidents of a railway accident contribute to form a combination of the most terrible circumstances of which it is possible for the mind to conceive. The vastness of the destructive forces, the magnitude of the results, the imminent danger to the lives of numbers of human beings, and the hopelessness of escape from the danger, give rise to emotions which in themselves are quite sufficient to produce shock or death itself. All that the most powerful impression on the nervous system can effect is effected in a railway accident; and this quite irrespectively of the extent or importance of the bodily injury."[2] A great many cases appear under the conditions above mentioned presenting no lesion; which are purely of a functional character, and arising from psychic shock, traumatic hysteria, neurasthenia, and persistent ultimate effects.

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[1] "Surgical Enquiries," second edition, page 37.

[2] "Railroad Injuries, their Medico-Legal and Clinical Aspects," Herbert W. Page. Charles Griffith & Co., London.

PSYCHIC SHOCK LESS UPON EMPLOYEE THAN PASSENGER.

There can be no doubt that familiarity and experience with dangerous elements have a tendency to lessen pyschic shock. Where employees have been upon the same train at the time of accident where passengers were injured, psychic shock has rarely been so intense in the former as in the latter. Of course there are conditions of shock in both which can never be overcome—but as a rule the condition of employees in this respect is certainly better than that of passengers. This conclusion is the result of some years of observation and investigation of collisions and derailments occurring upon the railway, where both passengers and employees that had been injured were placed under espionage in the hospital.

It is but natural to suppose that the employee in his daily life becomes familiarized with the attendant elements of excessive momentum, power, and accident.

It was our privilege upon one occasion to examine an engineer, who had undergone more than one collision and several derailments; after his engine had collided with a landslide he had been compelled to jump from the engine, alighting in the river. It was probably not over half an hour after this accident occurred that the individual was examined, and there appeared to be no evidence of psychic shock; and certainly his physical condition gave no indication of much physical shock.

Injuries arising from collisions, derailments, etc., present traumatisms of extreme variety. Thus in the overturning of cars and their consequent dragging or tumbling in collisions, and their falling from heights, as in the breaking-down of bridges, or their passage into an open draw-bridge, the injuries are all dependent upon the extent of contending forces. It will be found that passengers in consequence of the nature of their surroundings are exposed to injuries to all parts of their economy.

LIST OF THE CHARACTER OF INJURIES GENERALLY AFFECTING PASSENGERS.

In 844 injuries to passengers, tabulated by the writer, the following results are shown: The head and face received 161 injuries, 66 of which were simple abrasions of the face. There were 9 fractures: 5 of the skull, 2 of the inferior maxillary, 1 of the nasal bones, and 1 of the right malar bone. Scalp wounds were 144 in number. There were 19 injuries to the head under contusions, 4 concussion of brain; the remainder were lacerated and contused wounds. The upper extremity received 148 injuries; the lower extremity 117. The trunk or body received 87 injuries. Dislocations were 11 in number: 5 of shoulder-joint, 2 of knee-joint, 2 of elbow-joint, 1 of hip-joint, and 1 a compound dislocation of ankle-joint. Fractures were 50 in number, 11 of which were of ribs. The superior extremity sustained 18; the inferior extremity 14; the remainder were of clavicle, pelvis, and fingers. Injuries to the back were 127 in number, including contusions, sprains, and concussions. There were 95 lacerated wounds on various portions of the economy. Burns, scalds, incised, punctured, and penetrating wounds constitute the remainder of the injuries, with the exception of 38 fatalities. Many of these injuries were combined with contusions and excessive ecchymosis. Out of the entire number, 844 injuries to passengers, as specified, only 13 developed into traumatic neurosis, 4 cases of which were plainly simulated, the others presenting more or less truthful pictures of this condition. It is natural to suppose, where persons are enclosed in the narrow confines of a passenger coach, and where, in the event of either a collision or derailment, they are jolted and thrown to various portions of the coach, striking whatever impedes their course, that contusions and concussions will be excessive.

VARIETY OF WOUNDS ARISING FROM DERAILMENTS AND COLLISIONS.

Outside of psychical shock, palpable lesions are manifest in lacerated wounds of extremity, head and other parts, produced by the persons being impelled forcibly against objects more or less pointed, or being caught in seats and detached portions of the car; incised and even punctured and penetrating wounds are caused by broken glass from windows and lamps; burns and scalds are produced by the breaking of hot-water heaters and stoves; almost every variety of wound may be produced, the incised, the punctured and penetrating, the lacerated, the contused, and even at times the poisoned wound, the latter caused by the penetration of pointed objects carrying with them substances of a poisonous character.

Burns and scalds affect passengers and employees alike, although the conditions are somewhat different. Passengers, in the overturning of coaches, causing the upsetting of stoves[1] or involving the integrity of hot-water heaters and the breakage of kerosene lamps, receive the various degrees of burns as exemplified, first, in simple erythematous inflammation of the skin; secondly, in erythematous inflammation of skin with vesication; thirdly, in partial or complete carbonization of skin and, as we have seen, complete carbonization of skin, muscles, and bones. Scalds seem to possess more fatal elements as a general thing than burns, as the saturation of the wearing apparel with steam and boiling water cause excessive injury to parts with great rapidity. The consequent frequent deformities arising from this source make them an object of extreme interest, not only to railways but to individuals.

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[1] Adams in his book on Railway Accidents speaks of the Angola horror on the Lake Shore Railway thus: "A ravine was spanned by a decked bridge 160 feet in length, with an abutment of mason work some 40 feet long. The forward axle in rear truck in rear coach was slightly bent; while in transit, the defective axle struck frog, derailing cars, which were dragged in one instance 1,200 feet. Just before reaching bridge next car was thrown from track, one car slid down the embankment some 30 feet. Though this car was badly wrecked, but a single person in it was killed. His death was a very singular one. Before the cars separated from the train, its roof broke in two transversely. Through the fissure thus made this unfortunate passenger was flung, and it then instantly closed upon him. The other car had fallen 50 feet and remained resting upon its side against the abutment, with end sharply downward. It was mid-winter and cold, and, as was the custom then, the car was heated by two iron stoves placed one at each end, in which wood was burned. It was nearly full of passengers. Naturally they all sprang from their seats in terror and confusion as their car left the rails, so that when it fell from the bridge and struck violently upon one of its ends, they were precipitated in an inextricable mass upon one of the overturned stoves, while the other fell upon them from above. A position more horrible could hardly be imagined. Few if any were probably killed outright. Some probably were suffocated; the greatest number were undoubtedly burned to death. Of those in the car, three only escaped; forty-one are supposed to have perished."

INJURIES TO THE THORAX, ITS WALLS AND CONTENTS.

Injuries to the wall of the thorax are frequent in railway accidents,[1] but they are rarely attended with serious consequences. But an excessive and astonishing amount of damage may be done to the viscera within, without any visible external evidence presenting itself. Under extreme and exceptional circumstances shock alone may be severe enough to prove fatal, and still no external evidence be present. The wonderful resiliency of the chest-wall may be at times an aiding factor in causing injuries to the contained viscera, when excessive compressions and contusions occur, rupturing vessels, lungs, the pericardium, or heart. It is asserted "that the heart appears to exhibit results of concussion in many respects analogous to those manifested in concussion of the brain; indeed, fatal results have followed such injuries where even on autopsy no alteration was discovered."[2] When no external evidence of injury presents itself, the only sign is extreme shock, with great distress, and, at times, rapid and almost instantaneous failure of heart; dyspnœa is always present; sometimes it is immediate, or it may not occur for some time. Pain seems dependent upon severity of condition. It may be very acute, or completely enshrouded by shock and distress. Confused sounds of the heart are frequent, either audible or subnormal. The ultimate effects of such injuries, when tending to chronicity, of course depend upon the extent of the original injury. Tachycardia, intramural and valvular cardiac troubles may supervene. Excessive contusion or compression of thorax may cause rupture of lung more or less extensive, producing hæmoptysis. Emphysema occurs where there has been no fracture of the thoracic walls, and may under certain circumstances mask the condition of the injured lung. Vibert says "that it is not possible to reveal this condition by auscultation or percussion where the rent is located in a central part of the lung."[1] Permanent impairment of the function of the lung is dependent upon the extent of the injury to the lung. It is hardly necessary to refer to such various conditions produced by trauma as pleurisy, pleuritic effusion, and pneumonia, since physical signs are usually manifest which can be used to measure the extent of the changes engendered.

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[1] Thus out of 21,939 railway injuries tabulated, we find 373 contusions and contused wounds inflicted upon various portions of the thorax. There were 68 ribs fractured, and in three instances the fractured ribs punctured the lung substance. Hæmoptysis was present and pneumonia developed in 3 cases; pleurisy developed in 11 cases, and was followed by effusion and chronicity in 4 instances; the sternum was fractured in 2 instances, fractured at the junction of the manubrium with the gladiolus in both cases.

[2] "American Text-Book of Surgery." Pub., W. B. Saunders, Phila., 1892.

Injuries to the Digestive Apparatus—A Consideration of Entasis.

It is not extremely unusual to find, following railway injuries, disorders in connection with the digestive apparatus. Under certain diseased conditions, enlarged organs or relaxed conditions may favor rupture or laceration of the attachments of the organs. The extremes of force seem able to produce these effects. Severe shock follows their infliction. At times, blows upon the abdomen affect not only the walls but the viscera contained within. Vomiting is at times a very prominent symptom after railway injuries, dependent frequently more upon purely hysterical conditions than upon traumatic consequences; indeed, malingering of a most pronounced type finds its expression in self-imposed emesis and requires close study and acumen to determine its cause. As a general rule traumatisms of the abdomen present the usual and well-defined attempts at repair, or, properly expressed, inflammation; but, of course, the diagnosis in many of these injuries depends entirely upon the manifestations of their secondary consequences. Vomiting of blood may arise from a simple bruising of the mucous membrane of the stomach, while an extensive rent in the stomach may not produce hæmatemesis.

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[1] Vibert says: "The pulmonary lesions which I have observed ought to be divided into two groups: first, there is a contusion of the thoracic walls: second, the walls remain intact and the disorders produced can only be explained by the concussion to which the whole mass of the body has been subjected, the effects of which are especially noticeable after thoracic contusions. And they are interesting, because, on the one hand, they persist very long, and, on the other hand, it may happen that they do not present any appreciable signs on auscultation and percussion. Hæmoptysis, consequent upon traumatism of the thorax, is explained by a tearing of the pulmonary tissues, which may occur without any fracture of the ribs and with an intact pleura. If this is located in a central part of the lung, and it does not form a large cavity, it cannot be revealed by any appreciable sign by means of auscultation and percussion. We know moreover that a tear of little extent can cause abundant and repeated hemorrhages, provided it involves vessels of a certain calibre."—Guillemand.

C. Guillemand, in his work on "Railway Accidents and their Medico-Legal Consequences," thus refers to a new morbid condition: "Dr. C. L. Coutaret, of Rouen, described in the French *Lancet* or *Gazette*, February 19th, 1891, a new morbid condition under the head of 'Entasis,' which consists of a traumatic lesion in a limited region of the organism produced by muscular effort; claiming that he has observed entasis to occur under diverse conditions, particularly during railway accidents, either among the workmen or train crew, and in travellers during wrecks and derailments. He divides entasis into two kinds: external and internal. In external entasis he has included rupture of muscular fibres more or less numerous, resulting from sudden or violent contraction, as found in traumatic lumbago so frequent among railway employees. He included under external entasis inguinal, crural, and ventral hernias, produced by an intestine which under the influence of an effort opened for itself a passage through a closed canal, or through the muscular layers themselves. Violent, unexpected, sudden, and exaggerated motion frequently leads to the stretching of tendons and tendinous sheaths. Under certain conditions the nerves themselves, more particularly the sciatic, are thus affected, resulting in neuritis. According to Coutaret, in internal or visceral entasis, the morbid processes present different conditions. When a person makes an effort, and all the muscles enter into play at one time, there is muscular synergy. Suppose at a given moment the effort acts slantingly; synergy then ceases to exist and non-acting muscular regions of the body remain inoperative, while the other muscles contract in unison. The organs situated under the non-acting area, having lost the uniformity of compression, are exposed to the by-play of force and gravity, which stretches and pulls at the organs even to the extent of tearing their attachments or their parenchyma. Falls, sudden and unexpected accidents, taking the muscular system unawares, are capable of producing internal entasis. Entasis (internal) is grave according to the region involved, and particularly so when it involves the gastro-intestinal apparatus; for serious conditions are engendered which tend to chronicity. It differs from entero-ptosis in the fact of its sudden production and the consequent inflammatory complications. Entero-ptosis, on the contrary, comes on with extreme slowness, and consists in a permanent prolapse of all or part of the visceral region of which the supporting ligaments have been progressively extended and the sustaining angles obliterated. Entero-ptosis is essentially passive, and is never complicated by inflammation. He refers to what he calls entasic dyspepsia. Internal entasis occurs generally in the subdiaphragmatic region. At the moment of the accident, and during the first few months following, the patient feels an acute pain in the region where the *contra-coup* is located. This pain increases with the least effort. The patient says he feels as if his stomach had been unfastened. From now on he loses his strength, becomes dyspeptic, and incapable of lifting weights. These symptoms naturally are proportionate to the gravity of the local lesions. Thenceforth all work will retard the cure. These factors are explained as due to a rent in the attachment or a tearing loose of the reflections of the peritoneum. The friable organs contained in the upper part of the abdomen may be torn and fissured; from this may occur a circumscribed peritonitis, either perihepatic, retrogastric, or perisplenic, according to the precise point on which entasis has acted. This peritonitis is of a very adhesive nature. The exudate generally becomes absorbed in course of time, and health and strength then return. But the termination is not always so favorable. If the traumatism has been very violent and has acted on a very large surface, the peritonitis will be more intense; nevertheless it has no tendency to spread, and remains localized at the point where it is developed. The injured party continues to aggravate his disease or prolong it indefinitely, if he does not abstain from all work requiring muscular effort. Rarely the circumscribed peritonitis ends in suppuration; the pus then opens for itself a passage through the skin or through the viscera—being vomited, or passing by the rectum as very fetid sanious pus. This termination by suppuration is exceptional; the disease generally remains localized and without pyogenic tendency. A complete cure may occur, but even in these cases with a rational treatment entasis may take from six to eighteen months and even two years to reach this favorable termination. Entasis may also produce hæmoptysis, uterine displacement, or hæmaturia followed by nephritis."

AN ANALYSIS OF ENTASIS.

Coutaret's views regarding so-called entasis have been given for purpose of comparison. The writer, after years of experience, has failed to notice a condition corresponding with internal entasis and entasic dyspepsia. While admitting that the stomach is susceptible to the action of force as detailed by Coutaret, it must be stated at the same time that the trauma is evident as a general thing from the beginning, and is made manifest by the usual inflammatory symptoms. We do not believe that the character of chronicity is very often present. Certain it is that injury to the abdomen, and particularly to the stomach entailing functional disorder, is very infrequent in railway injuries; for we find, as a rule, that where excessive force is applied over the epigastric region, as in injury inflicted while coupling cars, or in impalement by projecting timbers, the injured individuals very rarely survive. Thus, among 21,939 injuries tabulated, there were only 55 well-marked and plainly indicated injuries to the abdomen. While functional troubles of the stomach were manifest on many occasions, direct traumatism was not the cause of them. The natural protective power and instinctive flexions of the trunk, the construction of the thorax, its overhanging walls, the deep concavity of the diaphragm, and the powerful muscles of the abdominal wall, seem to be well able in a majority of instances to protect the stomach and other viscera. And aside from this fact, we do not believe that it can be demonstrated that we can have asynergic action of the abdominal muscles when the persons are in healthful conditions.

Among the abdominal injuries occurring we have contusions and abscesses of the abdominal wall; but not a single instance is mentioned where the stomach alone was involved, and no instance where the gastro-intestinal apparatus, as described by Coutaret, was affected. Employees, when discharged from hospital, always settled with the claim agent upon a basis of reemployment; and it would be strange not to have employees return to the hospital when sickness or indication of a return of the trouble from an old injury occurred. We find no entry made of a condition such as described by Coutaret: "At the time of the accident, and during the first few months following, the patient feels an acute pain, which gradually becomes worse. There is loss of strength; and dyspeptic symptoms now appear, with inability to lift weights. There is localized peritonitis, with possible formation of abscess. This all brings about invalidism generally lasting from six to eighteen months, and as long as two years." Certain it is that in 7,218 bedside histories, we fail to find a single instance which in any manner approached the description given by Coutaret of internal entasis and entasic dyspepsia. The very nature of the surroundings of railway employees, the intensity of the occasion, the instantaneousness of thought, and the rapidity of muscular activity, would certainly more likely occasion entasis within them than in any other class of men. Thus in 18,885 railway injuries occurring to employees, 939 were caused by jumping off trains in motion; 826 by falling from trains in motion; 626 in derailments; 447 in collisions; and 3,662 under conditions where muscular activity of the most strenuous type was used under the most instantaneous and unforeseen conditions. Effort in collisions, in jumping off trains in motion, and falling from trains in motion, certainly would engender asynergic muscular action if any condition could. As indicated, the greater number of these accidents, occurring particularly where trains were in rapid motion, and often without the least admonition, and that too under circumstances of the most terrific form, it certainly seems that these conditions would take the muscular system completely unawares. But in an experience of many years, we have found no such cases as are described by Coutaret. It is true that abscesses have occurred in the abdominal walls, but never a condition corresponding to entasic dyspepsia. Again, a diseased state so plainly marked as that drawn by Coutaret could not be obscure. That previous circumstances could predispose to internal entasis and entasic dyspepsia, there cannot be much doubt. Enlarged organs, relaxed and anæmic conditions, and neurotic predisposition might assist in their production. Its history as detailed by Coutaret confines it in proper limits. Its occurrence certainly is of great rarity.

SO-CALLED CONCUSSION OF BRAIN—IMMEDIATE AND ULTIMATE.

Among the effects of derailments and collisions in consequence of limited and forcible surroundings, as in the narrow limits of a passenger coach, so-called concussion of the brain is somewhat frequently produced. It was formerly considered that concussion of the brain might be produced by a blow upon the head; that at times it was sufficient to produce functional disturbance, and still not cause any alteration in the brain structure. Owing to the fact of the extreme rarity of post-mortem investigations but little was to be determined about the pathology of concussion; hence it was assumed that vibrations of the cerebral mass, of even a slight degree, if continued long enough, as well as a violent vibration, were competent to suspend more or less completely the activity of nerve cells; that if only the cortex was affected the depression was transient, but if the ganglia at the base of the brain were involved, particularly the vasomotor and cardiac centres, the consequences were serious and more lasting. Shock and cerebral symptoms were then combined. Older authors frequently detailed cases of paralysis, epilepsy, and insanity occurring from this source.

Considering the newer ideas regarding concussion of the brain, it assumes medico-legal aspects, and presents problems worthy of proper interpretation, when its far-reaching and deleterious ultimate effects are considered. The term "concussion" is now considered by advanced authors as being an unfortunate appellation; for it conveys an idea of functional trouble, when in reality there oftentimes exists an organic lesion. Slight injuries of the brain might be called concussion, but in many cases it would be better to use the expression of laceration as an equivalent for concussion. The forces producing laceration of the brain may act directly or indirectly: directly where the blow is received upon the head; indirectly where the blow is received upon a distant part, producing concussion or laceration by the transmission of excessive force and vibration, as is found where individuals alight upon their feet after falling from a distance; or where they are propelled by force and alight upon their buttocks, as we have seen in two instances. One person was thrown by the pilot of an engine on a fast train over a railway coach, alighting upon his buttocks on a pile of lumber. Concussion or laceration of the brain was plainly produced. There was unconsciousness, seeming recovery, and finally termination in a paretic condition.

In another case, where an engine exploded while in transit, the fireman was thrown, as explained by a witness, first upon his feet, after which he bounded back upon his buttocks. The injury was followed by clouded intellect, and then partial recovery. It terminated eight years afterward in progressive paresis. The manner in which direct and indirect forces cause laceration is explained by an experiment made by Felizet, who filled a skull with paraffin and dropped it on the floor. The skull was then opened; no fracture was found, but at the point of impact the bone had been driven down upon the paraffin and flattened it, and had sprung back, without fracture, to its original place. Thus the extent of force affecting the paraffin was indicated by the degree of the resulting impression. It is evident that this condition frequently affects the living brain, producing depression and mechanical injury of the brain commensurate with the degree of force applied, with more or less laceration of brain tissue and rupture of blood-vessels.[1] The prognosis is always doubtful in any of these cases which are sufficiently severe to produce unconsciousness, as serious results may follow after long intervals of time. Paralysis, abscess of brain, epilepsy, and insanity are among the results attributed to such injury.

AMPUTATIONS CONSIDERED.

It would not be necessary to refer either to amputations or compound fractures, particularly in their medico-legal aspects, if it were not for the fact that most works on medical jurisprudence seem to maintain ideas that are not in strict accord with the advances made in and the new conditions engendered by the progress of time. Our only excuse is that the conditions under which railway injuries occur at the present time are certainly changed from those that formerly prevailed.

Elwell[2] says: "The operation of amputation is resorted to both in the cure of injury and disease, and in both the removal of the limb at the present day is comparatively rare. The resources of an improved art are successfully applied to the treatment of disease, while we are taught by experience and by reason to place a fuller reliance upon nature for the cure of injury." Certainly he did not have in mind the passage of wheels of ponderous locomotives and cars over parts of the human economy, by which the soft parts are pulpified, the bone triturated, muscular continuity destroyed, and vascular connections obliterated, and living tissue devitalized in an instant. Owing to the great increase in weight of locomotives and rolling-stock on the railway, more pronounced injuries are inflicted than ever before. No question can, as a general thing, be raised as to the propriety of amputation where the inflicting agent has already done that in its ponderous rough way. The only question arising is as to the time of operation with reference to an adaptability as regards the violence of shock, the probability of reaction, and the condition of tissues beyond the immediately evident seat of injury. It can be verified whenever desired, that where rapidly revolving wheels pass over parts, attrition of the skin to tires and flanges of wheels frequently twists the skin far beyond the seat of its contusion and laceration, so that at times a problem is presented in determining whether the integrity of the cutaneous flaps can be trusted. Conditions frequently present themselves where shock is extreme, and where the approach to a higher point in amputation would mean increasing shock and consequent death. In these days, when almost entire dependence is placed on cutaneous flaps, the determination of the condition of the skin after these injuries is important; for under certain circumstances, with existing shock, we are unable to distinguish the uninjured from the injured skin by any known means; whether by the application of any instrument of precision, by sense of sight or of touch. This twisting process generally robs the skin of its integrity, rupturing and contusing vessels and nerves, and destroying the elastic felting of the skin. Many re-amputations have to be made in consequence of using lifeless skin. Experience teaches that amputation frequently performed under these conditions minimizes shock, and we are thus enabled to save life; when, if a higher amputation were at first resorted to under ordinary circumstances, in many instances there would be a fatal termination. Consideration of the existing shock by the surgeon is a potent factor in the saving of life. We are justified in refraining from amputation under the new conditions made possible by antiseptic surgery, where septic conditions can be kept under control. Nowadays good sense always justifies refraining from amputation when adverse conditions exist. In former years septic conditions compelled immediate action; now the mangled and shredded tissues can be removed and amputations made when physical conditions justify them.

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[1] *Loc. cit.*

[2] "Medico Legal Treatise on Malpractice," p. 8.

Many surgeons have, by legal processes, suffered severe penalties in consequence of errors of judgment, oftentimes committed under such circumstances. While ordinary care and skill are demanded by the law, after such injuries we have conditions frequently produced where extraordinary skill and care cannot always interpret aright; and frequently an impression is conveyed to the laity or judiciary, on these matters, which plainly engenders the idea of a positive lack of knowledge and skill on the part of the surgeon.

FREQUENT COMBINATIONS OF PSYCHIC AND PHYSICAL SHOCK —THEIR EFFECTS, AND ILLUSTRATIONS OF EXTREMES.

It will be found that where we have the union of physical and mental shock, results seem to be proportionate to the gravity of these elements combined. We have seen comparatively trivial injuries, when in combination with mental shock, render the patient's condition extremely grave; and again, we have seen extensive physical injuries present a minimum amount of shock, which could not be interpreted under the head of masked or delayed shock, but plainly was due to a temperament lacking in nervous sensibility. We have repeatedly seen drunken men injured where shock was not profound in proportion to the physical injury, probably owing to the obtunding influences of stimulants.

In illustration of a marked case of shock, we will cite the following instance: A gentleman, while walking upon a railway track, was suddenly faced by a fast-coming train. He immediately stepped off the track on to the track of the opposite side, to be almost instantly met by another train, when he stumbled and fell with one foot partly on the track. Only the ungual extremity of the great toe of the right foot was crushed. Upon examination severe shock and mental disturbance were present. The injured parts were attended to; and no other injury could be found upon the person, beyond a bruise of the left olecranon process. He gradually sank, and died eighteen hours after accident. Post-mortem made by coroner; no diseased condition was manifest, and it was plainly a case of death from extreme mental shock combined with trivial physical injury.

The following case is an example of great physical injuries presenting comparatively no shock:

A switchman, while switching cars at night, caught his foot in a guard-rail, and before he was aware was knocked down and run over. The left thigh was crushed within two inches of the hip-joint, and the left arm within two or three inches of the left shoulder-joint. Extending along the outer side of the left thigh and abdomen was ecchymosis, marking a plain line where the flange of a wheel had separated skin from the side of thigh and abdomen as high up as the eleventh rib, so that the hand could be introduced (owing to separation of skin) up to and over the abdominal muscles of that side almost to linea semilunaris. The shoulder-joint was disarticulated, the shredded tissues were removed from the thigh, and the soft parts were amputated on a level with the crushed bone. Upon examination there were hardly any evidences of physical shock: pulse good; skin, while pale, not bedewed with cold clammy perspiration; sphincter ani muscle not paralyzed; had retention of urine; no huskiness of voice; in terse, the usual manifestations of shock but feebly represented. He was mentally clear, and in explanation as to how the injury occurred, said: "If I had seen what hit me I might have been scared. It was done before I knew what happened to me; and if I had known that my arm was crushed too and gone, I would have put my head under the wheel." Had this individual suffered psychic shock to any great extent; had he seen the inflicting agent coming when realizing that his foot was caught in the guard rail, there can be no doubt that he would have suffered greatly from mental shock and the result certainly would have been different. He made an uninterrupted recovery.

While admitting that suddenness and extent of injury are potent causes of shock, we cannot refrain from believing that psychic shock is almost as potent. The gravest injuries which we have ever seen to occur upon railways and recover have been among employees where familiarity with dangerous conditions seem to lull the mental impressibility of the individual. Hospital records of injuries occurring at night to employees, where the completest elements of sight are not pronounced, seem to debar the excessive play of psychic shocks. A series of unusual recoveries strangely attend the occurrence of injury at night. We do not doubt that when passengers are confined in the narrow limits of a passenger coach, and where capricious gravity plays uninterruptedly with the passenger, uncertainty, darkness, apprehension of danger and trauma may produce their profoundest psychic effects. We can readily conceive where mild influences are likewise not without effect.

SEVERITY AND COMPLICATIONS OF COMPOUND FRACTURES IN RAILWAY INJURIES.

Compound fractures from railway accidents, as indicated before, possibly do not present any elements differing from those inflicted elsewhere, yet their common severity and complications naturally make them a pronounced injury.

By compound fracture we mean a fractured bone where the seat of fracture is brought into communication with the external air through a wound of the soft tissues. A fracture is comminuted when the broken bone presents several distinct fragments. A fracture is complicated when lesion of an important artery or nerve co-exists; when disease of the broken bone has existed previously; when dislocation has been produced at the same time with the fracture; or when there is a wound or any other lesion, near the seat of the fracture, which does not communicate with it. In no vocation of life, where these injuries occur, do we find any greater differences regarding degree, especially in comminutions and complications. In the passage of car-wheels over a part, for reasons not easily explained, the skin may remain intact, and all of the intervening tissues, muscles, vessels, and nerves may be pulpified, and the bone comminuted excessively. In the strict interpretation of definition, this comminuted bone would be classed as a simple fracture or simple contusion, when in reality no compound injury at any point possesses graver conditions. Since the introduction of antiseptics and aseptic wound treatment, no greater advancement in treatment has been made in any class of injuries than in the treatment of compound fractures. Almost the entire element of danger has been eliminated from a class of injuries formerly presenting elements of great danger, and often resulting in amputations, septic conditions, and death. Thoroughly antiseptic treatment places it within the power of the surgeon to obtain results which are impossible without it. An older treatment had to face conditions which, in order to be coped with successfully, required a keen study of every adverse element; and conditions were presented which demanded rapid, intelligent, and well-directed effort. Not only was excessive deformity constantly met as a result; but systemic conditions often accrued in consequence of the time required in obtaining results, which led to the acquisition of an infirmity which remained through life. When septic infection was removed as an adverse factor, the mechanical element of treatment assumed an exactness almost as definite as that used by the mechanic who works upon inanimate materials. These mechanical elements thus made available are multitudinous. Nails are driven into bone, particularly young bone, to approximate broken surfaces; drills are bored through bones and left *in situ* to retain broken surfaces in apposition; wires and osseous ferrules are applied around bone to hold broken surfaces together; in short, a mechanical condition was met by mechanical means, and a judicious application of drainage, along with a close study of antiseptic necessities. Since the introduction of the antiseptic or aseptic treatment of wounds, particularly in the treatment of compound fractures, the assertion has frequently been made that, so long as vascular connection is intact, we are justified in treating all cases of compound fracture. This holds good except under certain conditions frequently met in railway accidents, where we have an excessive loss of soft tissues. We have seen skin and muscles stripped off the anterior part of a leg while the posterior parts remained almost intact, with blood-vessels uninjured, the destruction of tissue being so great and the comminution of bone so excessive that under the most favorable conditions repair meant excessive loss of time and great deformity; this deformity being far more excessive than if amputation had been resorted to, and proper prothesis applied. Again, a compound fracture of the femur with comminution means, under almost any circumstance, a series of difficult conditions to contend with. The deep situation of this bone, surrounded by layers of muscle and intermuscular spaces; the importance and size of its nerves, make it a problem somewhat unusual and difficult. While its vascular supply may be intact, still, even with antiseptics at command, with drainage applied, and with the most studied care, it is doubtful at times whether treatment of this compound fracture is as judicious as its removal. The main element determining its treatment is the destruction incidentally of bone and soft tissues and the quantum of shock existing. Months will be employed in accomplishing cure, and deformity is a certainty. There are conditions arising where expediency will indicate that the best plan is to adapt the treatment to the conditions as they exist and arise. Thus an employee of the railway fell upon the track, when two forward wheels of the forward truck of a box car passed over the left thigh at the junction of its middle and lower third. The bone was excessively comminuted, with great laceration of muscles on the anterior portion of the thigh. The muscles on the outer portion of the thigh were almost severed. The femoral artery remained uninjured, for some unknown reason. Upon examination shock was found to be profound, with a clouded mental condition. To amputate at once would have been to still further accentuate shock, and it was thought would lead to death. The parts were treated antiseptically, and splints applied. The mental condition became worse; delirium continued for a month or more. The treatment was continued for over eighteen months, and the patient was discharged with the limb six inches shortened, but he was competent to pursue a circumscribed vocation.

Conditions, of course, must be our guide even with the great advancement made in the treatment of compound fractures occurring in railway injuries. Still some adverse conditions debar the possibility of always obtaining good results. Deformities will certainly more frequently occur since the introduction of antiseptic surgery, because greater chances are taken in saving limbs than ever before; and common sense indicates that a limb, even though deformed, is, as a rule, better than any prothetic apparatus.

As indicated, we thus speak freely of compound fractures in railway work for the reason that oftentimes their severity and degrees place them beyond the pale of consideration in the category of ordinary compound fractures. And in many instances a deformity will arise, where, in consequence of good sense and good judgment, a life has been saved, and the part is restored to partial usefulness. Points of medico-legal interest are certainly likely to arise in connection with these conditions. Amputations at best should be only a last resort consequent upon the failure of other treatment. An extensive compound fracture, although followed by deformity, would indicate oftentimes that more than ordinary skill, judgment, and treatment had been employed.

INJURIES TO THE BACK—DIFFERENCE OF EFFECTS AND RESULTS—DIFFERENCE BETWEEN PASSENGERS AND EMPLOYEES OF THE RAILWAY.

There are marked differences between injuries to the back occurring to passengers and injuries of the same kind affecting employees of a railway, where grave symptoms are not immediately produced. We think that it can be plainly shown that these differences depend, in a majority of instances, upon the social surroundings of these respective classes. The same influences act violently upon the passenger and mildly upon the employee. We realize, too, that in many instances the extremes of physical conditions are met; namely, the employee as a general thing being physically perfect, while the passenger is frequently the reverse, aside from the fact of the passengers being mixed as regards sex. The following descriptions will illustrate the difference of effects produced by such injuries:

A man has been in a collision. He was perfectly conscious that he met with no blow; knows, in fact, exactly what occurred to him when the accident happened; and yet he finds that within a few hours, occasionally much sooner, he is seized with a pain in his back, gets worse, and summons a physician. Cause, railway collision! The physician expresses doubt, and suggests grave consequences. Railway injury; nervous patient; suggestion on suggestion continued; and then there is the development of a serious case—psychic influences possibly leading to traumatic hysteria or neurasthenia. In consequence there is complete withdrawal from activities of vocation. Then follow changed and circumscribed surroundings; solicitous friends; serious and solicitous physician; solicitous family; the engrafting of dire results mentally; circumscribed diet; abundance of medication; and finally litigation is thought of, with its continuation of unrest. All, of course, depends upon the mental strength and integrity of the individual himself, and the integrity of his surroundings. Such instances seem to be unusually frequent.

With the employee it is otherwise. Having been in a collision, and conscious of having received no blow, he knows exactly what occurred to him. If after a few hours or sooner, he is seized with a pain in the back, he remembers that he has had it himself before, or that he has seen many others with it. The expected has happened to him. He cannot lose time; he must work; his necessity is great, with a family to support. He gets a poor-man's plaster and applies it to his back, and tries to continue work. And frequently he accomplishes a cure by sheer force of determination arising from necessity. If a lack of rest produces a worse condition, he sees a doctor. Rest is prescribed, and a cure results generally with remarkable rapidity.

Traumatic lumbago arising from twists or sprains of the back, under circumstances of ordinary severity, owing to suggestive circumstance, means with the passenger an almost unknown quantity. With the employee, under favorable circumstances, the results are in proportion to the real damage inflicted.

This conclusion comes from daily observation with such patients under espionage in hospital.

Traumatic lumbago occurring in the farm-hand or other laborer, where surrounding circumstances are commonplace and natural, means a true interpretation of the extent of injuries in relation to existing physical trauma. We have taken this illustration of back injuries to show the difference of effects, because of their frequent occurrence; because they have been made a subject of constant and unceasing study and minute analysis; and because of their close connection with functional troubles which are so prolific a cause of litigation.

Frequency of Back Injuries in Railway Accidents.

Page avers that 60 per cent. of the persons injured by the railroad make complaint at some time of having been hurt in the back.

Probably it would not be out of place to show the comparative frequency of back injuries among passengers and employees of railways, where they have been injured under essentially the same conditions, as far as the application of force and the manner of infliction could be determined. Thus, in 18,885 injuries to employees, we have the back involved in 1,014 instances. Of this number, 509 presented only partial or no external evidence of injury. Concussions of the spinal cord numbered 26. There were 18 concussions of the brain and spine combined, as per reports. Again in 844 injuries to passengers we find 127 injuries presenting slight or no external evidence of injury to the back. The most plainly evident causes of these injuries are conditions where sudden and unexpected movement has been involved, with violent strains and wrenches arising from undue muscular exertion, sudden prehensile movements, and sudden jolts and jars as in alighting upon the feet; and concussion from force applied directly to the back.

A Fuller Consideration of Back Injuries where Objective Symptoms are Partially Lacking.

We will now consider those injuries presenting only slight or visible signs of injury to the back. We will not at this time speak of the sequences following these injuries, but of troubles mainly presenting objective characteristics, with the subjective elements causing their infliction, including, of course, the slight swelling present and the appearance of bruises incidental to back injuries, with such symptoms as pain, stiffness, and pseudo-paralysis as exemplified in the dread of motion which is consequently circumscribed by the attendant pain; and the ultimate appearance of a mild psychic change.

Structurally, the vertebral column is of extreme and confusing perplexity. We have but to recall its lenticular or intervertebral substance, plainly intended for the purpose of preventing the injurious effects of jars and shocks upon the vertebral column and the cord contained within; the anterior and posterior ligaments for preserving the integrity of the vertebral column; the arches of each pair of vertebræ girded and bound together by the ligamenta subflava, aiding in maintaining the column in its upright position, and by their contractions assisting muscular effort; its capsular ligaments and synovial membranes holding together the articular processes; its interspinous and supraspinous ligaments, fastening together the spinous processes of the dorsal and lumbar vertebræ; its intertransverse ligaments connecting the transverse processes of all the lower vertebræ; its eighty or more joints protected by ligaments, and additionally reinforced by aponeuroses and attendants, making each joint capable of more or less motion; and its muscular connection. Finally, there is the intimate relation of the spine to its nervous contents and coverings, and the nerves which pass out between its segments. Its numerous and varied relations certainly make it susceptible to injuries productive of a great variety of symptoms, which, in consequence, in their diversified character and the extremes of degree, are characteristic of railroad accidents.

WHY PSYCHIC AND PHYSICAL CONDITIONS ARE FAVORABLE IN THE EMPLOYEE.

There can be no doubt that, in young and vigorous persons, such as are generally found in railway service, particularly in the transportation department—conductors, brakemen, switchmen, and firemen—whose employment entails constant muscular exercise, the muscles are developed by unceasing daily training. In such person is certainly exemplified the most perfect muscular action, and the most instantaneous response and adaptation of muscles. It is difficult to measure the extent of this. At the same time, in such employees a familiarity with dangerous circumstances and a facility in muscular action are developed. It is but natural to suppose that it requires stronger twists and wrenches, or more forcible flexions and extensions—in short, more violent sprains—to inflict injuries upon the multiplex organization of the back of such individuals than in others, even with the help of sudden relaxation of muscles.

Knowing the wonderful influence of the mental element in any injury, how shock and collapse can come from fright, it would be natural to suppose that where these conditions of muscular development do not exist, a mild injury might be readily shaded into a grave one, aided by the strange and utterly unexplained production of hypnosis and suggestion by trauma.

A SPRAINED BACK GENERALLY DIFFERENT IN PASSENGER AND EMPLOYEE.

An ordinary sprain of the back, then, is an entirely different thing in passenger and employee.

It will not be out of place to state that our observation comes from the fact that all the injured employees are treated in hospitals directly connected with the company represented; so that we are sure as regards their surroundings, and the full influence and force of treatment.

With this explanation we find that the following conclusions have been substantially verified for the past sixteen years, and they do not depend upon aught else than the facts as they presented themselves.

The immediate surroundings of the employee when in hospital, as stated before, are such that there are no mental influences which are likely to cause exaggeration. Everything is favorable to an early cure. Suggestive conditions are minimized, while, as a rule, it is just the reverse with the passenger.

In the investigation of derailments and collisions, where even gravely inflicting forces have been operative, elements of psychic disturbance are never so evident in the employee as in the passengers involved. And in the subsequent treatment of both injured employees and passengers, there is a difference so marked that it cannot be explained save by the difference of the psychic condition of the passengers and employees.

Where the employee is placed under the most favorable circumstances of observation, suffering with a condition supposed to be due to excessive strain or laceration of some part of the vertebral fibrous or muscular attachments, with pain, tenderness, stiffness, pseudo-paralysis, and extreme difficulty in micturition and voidance of fæces, under proper treatment months were rarely consumed by the process of recovery. The fullest investigation shows that it is only under the most exceptional circumstances that a serious condition was produced; and in such cases organic nervous troubles, either inherited or acquired, were often demonstrable. The surroundings of the employee, while in hospital, are not filled with grave suggestion; solicitation is neither extreme nor affected; and the example of those surrounding the individual decries morbid self-brooding. The patient is impressed by the systematic, matter-of-fact conditions placed about him intentionally.

Of course, it is not meant that nature acts differently in the injured employee and the injured passenger of a railway; but with the injured employee the surrounding influences and suggestive circumstances are minimized, and for a series of years results have plainly indicated the salutary effect. The injured passenger is constantly rendered worse by every element of unrest, exaggerating surrounding circumstances, extreme solicitude, and injudicious suggestion; and we realize that the mental factor at times may engender conditions terminating in organic lesions. It thus becomes a pertinent inquiry as to who can determine the positive force of adverse surroundings. Certain it is that we can determine the favorable circumstances; that is, the positive influence of proper treatment and favorable surroundings; and we are forced to the conclusion, which we believe is correct, and can be successfully maintained, that adverse surroundings constantly modify mental conditions to such an extent that their ultimate results cannot always be easily prognosticated.

Intensity of Infliction as a General Thing Means Intensity of Effects.

It is not denied that "when suddenly and without warning, before a single muscle can contract, the body is wrenched, twisted, or thrown with overpowering force from one side of the carriage to the other, every muscle or ligament that has an attachment to the spine may be strained or hurt,"[1] as exemplified in the collision and derailment; for a study of the causes of these injuries plainly indicates that their action tends to produce intense rather than mild injuries. Such causes, along with physical and psychical shock, are certainly sufficient to engender neurosis, and ultimate plainly evident lesions. But when circumstances are ordinary, even though in a collision, the back symptoms following are the result in many instances of education, or of a prevalent thought, aided and assisted by solicitous, ill-advised, and pernicious surroundings.

Thus, no matter how "uneducated persons may be, newspapers and the talk of everyday life have filled their minds with the dread of the mysterious and baleful consequences that may happen to those who receive injuries, particularly in railway accidents" (Gray, "Mental and Nervous Diseases"). Hence nowadays it only needs suggestion and leading reminders, with consequent lack of rest following the positive influence of trauma, to intensify and stamp mild injuries profoundly.

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[1] Moullin, "Surgery."

Injuries to the back, as before stated, are of constant and frequent occurrence upon the railway, and they have been the subject of the closest investigation and analysis; so that the many unusual or seemingly abnormal manifestations attendant upon them have been made very familiar.

SPRAINS OF THE BACK—TRAUMATIC LUMBAGO.

Considering the wonderful complexity of the vertebral column, and the importance and variety of its relations, and, above all, that the welfare of the great nerve-centres depends upon its integrity, it cannot be surprising that injuries inflicted upon it constantly present elements of severity. Almost any injury to it, when accompanied with psychic shock, seems competent to produce serious and broadly felt effects, depending very largely, however, upon the condition of the individual at the time of the infliction of the injury.

We shall now consider injuries to the back presenting slight or invisible signs of external injury, resulting not only from collisions and derailments, but produced by excessive, unexpected, rapidly executed, and undue muscular effort, as expressed by surgeons' reports rendered in railway service, under the captions of "falling from trains while in motion," "jumping from trains while in motion," "boarding moving trains," "falling off bridges and buildings," "falling off hand-cars in motion," "falling from telegraph-poles," etc.

Many of the conditions produced by collisions and derailments are essentially typified by effects produced in the most ordinary manner. The injuries occurring upon railways, though often of the most extreme degree, cannot claim anything peculiar, or "altogether different determinable phase from injuries due the many other sources of violence," except, as expressed, where they are re-enforced by some peculiar nervous effect such as may arise from harrowing circumstances causing psychic shock.

Sprains of the back[1] are of very common occurrence upon the railway in consequence of subversion of gravity and concussion, as in collisions and derailments, and the suddenness of muscular exertion excited. Under such circumstances almost every condition tending to intensify these injuries is present in its most conspicuous and forcible form. The passenger is confined in the narrow limits of a coach. There is rapidity of motion and sudden stoppage, which takes place without warning to the individual, and, when muscles are at rest and relaxed, before a single muscle can protectively contract. A powerful force throws the individual backward and forward, or about in a variety of ways, forcibly flexing, extending, wrenching, and twisting the spinal column, and producing injuries at times of its joints and ligaments, and straining almost every muscle and ligament attached to the vertebral column. We will not here speak of the intensest effects produced further than to summarize. Sometimes extreme effects are produced, where the ligaments connecting the vertebræ are ruptured, especially the ligamenta subflava, which, in consequence of the bountiful supply of blood, causes immediate and severe extradural hemorrhage, which by its pressure produces a temporary paraplegia. Again, the meninges or the cord may be seriously injured, terminating in meningitis and myelitis.

DIFFERENT REGIONS OF BACK INVOLVED IN SPRAINS.

The lumbar region seems to be more frequently affected than all others of the column combined. This is due to its flexibility, its strong muscular attachments, the wide range of motion it allows, and the superincumbent weight. Next most frequent are cervico-dorsal sprains, which likewise arise in consequence of the flexibility of the parts involved; then come sprains of the whole vertebral column; and, last of all, sprains of the dorsal region, which rarely take place without fracture or dislocation of vertebræ, with consequent compression of the cord.

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[1] The word sprain definitionally means to weaken, as a joint or muscle, by sudden and excessive exertion; to overstrain; to stretch, as muscles or ligaments, injuriously, but without luxation of dislocation. —Webster's Dictionary.

Or the sudden shifting of a joint farther than normal conformation of bone and ligaments allow, yet so as not to produce dislocation.—Thomas' Medical Dictionary.

Again, injury and consequent soreness from a strain of a muscle or tendon by too great traction upon it.—Gould's Medical Dictionary.

It will thus be seen that the word sprain, as applied to injury of any part, is certainly vague and indefinite, indicating the resultant of a condition rather than the essence of the condition itself; its aggregate symptomatology rather than a definite description of the element most largely constituting the actual condition. But sprain of the back is certainly unusually broad and vague, as the back according to common acceptation of the term extends from the caput to the buttocks and embodies many structures.

Concussion may be applied along the column by direct blow but its effects are not always manifest immediately under the place where the concussive force has been applied; remote parts of the cord at times being affected through the transmission force. Page says that "the physical structure of the spinal column exposes it to this form of injury, back-sprains. It is endowed with great mobility in every direction, forward, backward, rotation, and from side to side, made possible by its many articulations, and its thousand ligamentous attachments; nevertheless it has to guard the spinal cord within its central canal. To do this well, conscious and unconscious effort is such that at the moment of collision the whole becomes rigid, and as a result of the violence and the sudden resistance induced by setting of the muscles and ligaments, the ligaments and muscular attachments are strained, overstretched, and may even be ruptured in the dorsal, lumbar, or lumbo-sacral region of the column. The injury is precisely the same as that which is met every day, where a man complains that while lifting a heavy weight he suddenly felt a severe and acute pain which almost prevented him from moving the lower part of his back. You examine him and find no external sign of injury, but he hesitates to stoop; and when you ask him to, he holds his back unnaturally stiff; and very likely there is some local tenderness in the muscular mass on either side of the lumbar vertebræ."[1]

SYMPTOMS OF TRAUMATIC LUMBAGO.

Simple traumatic lumbago arising from muscular strain may not develop until several days after the accident. Again, it may occur within several hours. Pain and stiffness are always present, and an inability to walk with wonted rapidity. Upon examination there is rarely present any objective evidence of injury. The usual evidences of the condition, provided, of course, that the circumstance of infliction has not presented any psychic shock, are generally in proportion to the physical effects produced, and constitute a plain, definite sequence. In violent lumbar sprain—pains in the small of the back—we have all the typical elements of intensity after an injury. Pain and stiffness extend across the loins. This pain may be at first dull and aching, and continuous during any effort to use muscles; movement excites an intense, darting pain which begins in the back, at times extending down the limbs and up the back. It is an agonizing pain, allied to the pain of an inflamed nerve, muscle, or muscular sheath; or such as certain low forms of tissue, when inflamed, produce.[1] Stiffness presents itself in a thoroughly rigid condition of the muscles. The back is held in a fixed position, partly from fear of motion producing pain, and partly reflexly from the slight injury inflicted upon nerves in their exit from foramina. Along with this condition, there is a difficulty in micturition and voidance of fæces, plainly owing to the constant fear of contracting lumbar muscles in these acts and producing pain. Finally, a mental condition develops which harasses the patient. A dread of ultimate serious consequences arises. Patients frequently imagine that they are paralyzed or becoming so. This assertion, or its equivalent, has been made in our presence not once, but many times, suggested from the palpable conditions which present themselves; namely, the sense of weakness, the constant pain on motion, the stiffness of the back, the utter inability to walk except at a laggard pace with pain at every step, and the inability to attend to the wants of nature, leading to retention of urine with consequent dribbling; and with all these, the mental tension incidental to a loss of rest and constant pain.

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[1] *Loc. cit.*

ILLUSTRATION OF LUMBAR SPRAIN.

The following case presents most of the elements which attend a severe case of lumbar sprain:

G. S., passenger on train and in Pullman car, aged 32 years, muscular and well developed, intelligent and unusually observant. He states that while standing in the aisle of the car, to avoid a collision the automatic car-brakes were applied to the train, suddenly stopping it. G. S., as he expressed it himself, "simply reversed ends." He claimed that he was thrown around "the periphery of a circle," alighting on right shoulder and arm. He was somewhat "dazed," to use his own expression, but immediately after the accident he "picked himself up." Not feeling hurt, he walked to the car platform to see how near the trains came to colliding. He continued his journey Pain in the small of his back slight; said he felt pain in the shoulder more than he did in the back. On the fourth day afterward stiffness of the back became pronounced. He was seen upon the evening of the fourth day after the accident, and presented all the evidences of severe lumbar sprain. At the patient's urgent request the examination was mainly colloquial. There was slight increase of temperature, but no other systemic effects aside from sprain were apparent. The patient thus described his own feelings: "I have a mixed feeling of weight and weakness. I feel like I imagine old Atlas must have felt when he carried the world, weighted, weak, and tottering. I can't move; for when I do, a stabbing, sickening, breath-robbing pain runs up and down my legs and back. I can't do anything in bed. When I get up, I am bent forward, my legs straddle, and seem bowed. Last night when I was in bed, a series of cutting pains extended in every direction from the middle of my back, and made my life miserable until I got warmed up. My mind is in constant tension from trying to dodge pain; a turtle is not more circumscribed to his shell than I am to my painless territory."

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[1] "When he tried to stand up, a sharp pain seized him in the back, like a knife cutting into him, and shot downward and upward from the loins like an electric shock, so that he dropped upon the floor."—Page. In one case in which the lumbar region was severely wrenched the patient described this pain as shooting like lightning down the legs.—Moullin.

This is a perfect description of the subjective symptoms of lumbar sprain. These symptoms continued more or less marked for nearly a month, gradually getting better. The only evidence of injury apparent was a slight bruise extending along right forearm. He resumed his vocation at the end of the second month.

Direct and Competent Force in Concussion.

When the intensity of the force frequently applied in these cases, and the comparatively slight physical damage resulting at times, are considered, we are impressed with the wonderful resistive power of this human frame. Force seemingly competent to break hard material substances may be applied, and yet it may produce no impression upon the individual when his protective powers are at his command.

In our own experience the histories of a great number of back injuries where paralyses were manifest, show plain, adequate force as a cause, either applied directly to the spinal column, or transmitted through the limbs and trunk. Hence, we cannot refrain from agreeing with and quoting Bramwell:[1] "It is very important to draw a line of distinction between cases of sprain of the back, or concussion of the spine, and cases of concussion of the spinal cord. It is no less important to come to a definite understanding as to the meaning of the term 'concussion of the spinal cord.' Some writers would seem to include under this term almost every lesion of the spinal column which immediately resulted from, or at a subsequent date followed, traumatic injury, whether applied directly to the spine or to the body generally. The term 'concussion of the spinal cord' should be strictly limited to those cases in which undoubted symptoms, indicative of derangement of the function of the spinal cord, were directly due to shock communicated to the cord as the result of external violence; and in which there are no obvious naked-eye lesions in the bones, membranes, or cord itself to account for the condition. The spinal lesions and diseases which result from traumatic violence might be arranged in the following group: 1st. Cases in which the spinal bones were fractured or dislocated, and in which the cord was contused or compressed by the bony lesion. 2d. Cases in which after a blow on the back, a twist of the spine, or a violent concussion of the spine, due to a fall on the feet from a height, grave and persisting, although not necessarily permanent, symptoms indicative of interruption of the function of the spinal cord immediately followed upon the receipt of the injury; but in which there was no evidence of fracture or dislocation of the spinal column. In these two groups of cases, the nervous symptoms—though they might differ in degree—are, practically speaking, the same; their significance is unmistakable. 3d. Cases in which, after a blow or fall on the back, or a twist of the spine, or a fall from a height, typical and characteristic symptoms indicative of undoubted disease of the spinal cord or its membranes were subsequently developed. In some cases of this kind distinct indications of derangement of the function of the spinal cord were observed immediately after the accident. In others, there were no immediate nervous symptoms; the spinal symptoms did not develop until after an interval, sometimes a considerable interval of time. 4th. Cases in which, after direct injury, such as a fall of stone or coal on the back, symptoms clearly indicative of concussion of the spinal cord occur. In colliers, concussion of the spinal cord seemed not infrequently to result from falls of coal or roof on the back. Colliers are, perhaps, more than any other class exposed to direct injuries to the back, in consequence of falls of coal and stone. Temporary paralysis frequently follows—paralysis of the bladder, temporary numbness, or temporary loss of power in the legs. The paralysis of the bladder persists for several days, or even, in some cases, for two or three weeks. The paralysis of the bladder, with loss of power and numbness of the legs, were evidently the direct result of sudden derangement of the functions of the spinal cord, and were produced by the injury to the back." His conclusions were, first, that falls of coal on the back frequently produced concussion of the spinal cord; secondly, that the symptoms indicative of such concussions were in the vast majority of cases merely temporary; thirdly, that colliers whose spinal cords had been "concussed" very rarely suffered from organic disease of the spinal cord or its membranes; and fourthly, that they very rarely indeed manifested the train of symptoms which so frequently occurs after railway accidents and injuries.

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[1] Dr. Byrom Bramwell: "Concussion of the Spine with Special Reference to Railway Accidents and Injuries."—London Lancet, August 12th, 1892.

It would appear from the various authors writing upon railway injuries that too narrow a view is generally taken as regards personal injuries inflicted by the railway. The passenger seems to be a constant theme; but it will be obvious to any one, upon the most casual thought, that the number of passengers injured upon a railway is relatively small in comparison with the injuries occurring among its employees. From statistics accumulated, eighteen employees are injured where one passenger is hurt. On many roads of well-regulated lines the average will run up as high as twenty-five employees to one passenger. Now it certainly would seem natural and just that, taking into consideration the intensely varied conditions in which employees are hurt, their injuries would more truly typify the real characteristics of railway trauma than those of the passenger. We do not agree with Bramwell when he says that many cases cited by him as occurring upon the collier do not occur among injuries on the railways; we are inclined to the belief that it will be found that almost as many direct blows upon the spinal column occur among railway employees as among the colliers. Certain it is, they are comparatively frequent.

The following cases present undoubted symptoms of concussion of the spinal cord, combining not only transmitted concussion but application of direct force to the spinal column:

Concussion of Spinal Cord.—J. Mc., brakeman, aged 24, while walking on top of a box-car while the train was in motion, struck his foot against a projecting nail on the roof of the car, stumbled, and fell from the car. He struck upon his feet imperfectly, and rebounded back on buttocks, striking his back against the projecting end of a tie or sleeper. He was rendered unconscious for only a short time, and in an endeavor to arise found that his legs were paralyzed; impossible for him to either feel or move them. He was brought to the hospital four hours afterward. Upon examination his pulse was rather feeble, temperature slightly subnormal; had vomited, and had retention of the urine. There was paralysis and loss of sensation of both legs. The area of anæsthesia extended irregularly above and below the anterior superior spinous processes. There were no signs of external injury, except a slight abrasion upon the middle of lumbar region. He complained of pain from the lower border of the last lumbar vertebra to the third lumbar vertebra. The bladder regained its muscular control next day. Under rest and an expectant plan of treatment, improvement followed somewhat rapidly. Sensation began to return to the extremities by the tenth day. The day following the accident he could move his toes, and by the end of the eighth day muscular power gradually returned. The case presented no remarkable features as regards recovery.

The following case is somewhat unique as regards the length of time involved in the treatment. It was plainly the result of concussion of the spinal cord, and presented some symptoms of brain concussion:

C. D., aged 24, brakeman, in service of company five months, admitted to the hospital December 25th. Patient states that on the night of his injury, while putting on a brake, the wheel of same came off, and he fell from the top of a box-car, striking his back against the rack of a coal-car some six feet below; thence he fell to the track, after which his head struck a tie, and he was rendered unconscious. Upon examination, complained of pain in the small of back; pupils dilated, but sensitive to light. Complains of pain about the middle of abdomen and a tingling sensation in his legs, along with inability to move them. Obtunded sensation from toes to near umbilicus. No external injury to back. Upon the sixth day he regained control of bladder, but he did not regain control of limbs until the fourth month.

COMPETENT AND POSITIVE FORCE GENERALLY NECESSARY TO PRODUCE CONCUSSION OF THE SPINAL CORD.

One who has had experience in this class of cases could not fail to notice the frequency of the occurrence of concussion symptoms which might be described almost in the same language used by Bramwell in describing similar symptoms in colliers.

There are various degrees of concussion of the spinal cord; at times the symptoms persist only for days; again, they persist for months. The causal conditions in the cases just related certainly seem competent to have produced the results that followed. In one instance the patient fell fifteen feet, and that, too, while the train was in motion, which added to the force of his fall. Then, after falling, he struck his back against a hard substance. Here we certainly had the full force of adverse conditions acting both in a direct and transmitted manner. Both cases essentially represent this condition. Undeniable injury was manifested from the beginning, and serious symptoms presented themselves at once. Had these cases developed subsequent troubles of a continuous character, it would have been natural to assume that the degree of force incidental to the infliction of the injuries was certainly competent to cause them. But when we see comparatively trivial causes produce the severest effects, possessing constant subjective elements, the only possible explanation is to be found in predisposition.

INFLUENCE OF RACE AND OCCUPATION IN THE PRODUCTION OF FUNCTIONAL TROUBLES.

There can be no doubt that occupation and race are potent causes in the production of ulterior results, and any one who has had experience in attending to the injuries of violence among the laboring classes, at least in this country, will come to the conclusion that functional troubles from traumatism, except where a predisposition exists, are of extreme rarity among them. Thus in 949 injuries among railway employees placed under the head of injuries to the back and spinal cord, and brain, but 8 cases of purely emotional and functional troubles were developed—that is, the so-called traumatic neuroses.

Strange to say, there was not a single negro among the number. The negro, in our experience, seems to be particularly free from functional troubles of this character.

Assuming that the number of employees above given had been injured, say in France, through the effects of collisions, derailments, etc., etc., it is highly probable that there would have been developed in this neurotic race a number far in excess of those here indicated. Hysteria and neurasthenia are plainly influenced by racial differences. There is no difficulty in proving that where the individual has developed his mental to the detriment of his physical powers, functional and emotional troubles are naturally frequent; and that in the reverse condition they are proportionately rare. Certain it is, that in railway injuries this difference is manifest. Who would ever expect to find, with a crushed leg, what is termed masked, delayed, or partial shock in an individual of the intellectual classes? Yet its occurrence among the powerful and physically well-developed laborers is not unusual.

We have records of some eighty-six injuries occurring to negroes who were in the capacity of passengers, and where derailments and collisions were the cause of their injury, but in no instance was there any such thing produced as traumatic hysteria or neurasthenia. The negro race is religiously emotional, and at times succumbs with unusual rapidity to acute effects; but upon the whole the negro's nervous organization is not nearly as readily influenced as is that of the Caucasian.

RELATIVE FREQUENCY OF SPINAL MENINGITIS IN BACK SPRAINS.

It is stated that among the possible occurrences after twists and sprains of the vertebral column and spinal concussion is spinal meningitis. Thus, Lidell,[1] referring to this subject, in a case where a wrench of the back was the cause of spinal meningitis, while not indicating in so many words that this is a constant occurrence, virtually suggests the idea that it is a somewhat uniform result. We find upon investigation of the literature in general that among the ordinary consequences of twists, sprains, and concussion of the spine, meningitis is mentioned as occurring with seeming frequency. In fact, to any one who is not thoroughly informed, the idea would naturally occur that every case wherein we had a wrench, a sprain, or a concussion of the back, spinal meningitis had to be unceasingly looked for; and that when it did not occur one might congratulate himself that a most serious complication had been avoided.

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[1] "Injuries of the Back," by John A. Lidell, A.M., M.D., "International Encyclopædia of Surgery," vol. iv., 1884. Wm. Wood & Co., N. Y.

In referring to this point, Lidell uses a somewhat sensational, but still illustrative, example afforded by the daily press. The description is just such as any reporter would make who had learned by word of mouth the salient points of a wrench, producing spinal meningitis. It is taken from a morning newspaper in New York:

"As one turns into Sixteenth Street off Union Square on the west side, one notices the tan-bark laid thickly in front of a handsome house in the middle of the block. Here lies G. G., the popular soubrette of the Theatre Comique. She stopped a car a few weeks ago, and the conductor started it before she had fairly got on, giving her such a wrench and strain that she felt at the time a severe pain in the back. From that day to this she has been unable to move, lying dangerously ill with spinal meningitis."

Here we have indicated by words from one of the laity, and used in illustration by a prominent author, the likelihood and seemingly undue frequent occurrence of spinal meningitis arising from the most trivial of sprains. Certain it is, that no sound-thinking and clearly reasoning physician, who has studied the subject, could possibly come to the conclusion that this condition could arise from such trivial cause, without some predisposing element to emphasize it. While realizing the possibility of spinal meningitis following these injuries, still it is a fact that it is of such remarkable rarity that it may not be met in a life-time of extensive experience with injuries. So infrequent is its occurrence that we are forced to the conclusion that predisposition is immeasurably the strongest element in its production. Placed in a position where we have seen muscular strains, extreme flexions, and extensions, along with spinal concussions and concussions of the spinal cord itself, as plainly evinced by symptoms following, it has never yet been our privilege to see meningitis follow such injuries. Its occurrence at any time, owing to its relative infrequency, makes it an exception. Hence it should not be considered as likely to be an attendant upon this class of injuries, unless they have a compound character. Medical literature is unusually defective on this point. We will admit that in children extremely light and apparently insignificant blows have produced meningeal troubles, but we certainly believe that there is no literature at present extant which will indicate that the adult has even an ordinary predisposition to their occurrence.

INFREQUENCY OF CHRONIC SPINAL MENINGITIS.

Bramwell[1] directs especial attention to "the extreme rarity of chronic inflammation of the membranes of the spinal cord—a condition which was supposed by some writers to be the cause of the nervous symptoms in cases of railway accident and injury—as the result of blows or falls on the back or other forms of injury. Injuries—severe injuries—to the back are followed immediately by distinct and definite symptoms indicative of concussion of the spinal cord and are of common occurrence. Such common diseases as transverse myelitis, locomotor ataxia, and progressive muscular atrophy can only in a very small proportion of cases be attributed to traumatism. It is a remarkable fact that these undoubted cord lesions are met with very rarely indeed in persons who have previously suffered from railway accidents or injuries. Some of these diseases were so common that on the mere theory of chances they ought every now and then to occur in persons who have been injured in railway collision. The wonder is not that they do occur, but that they so rarely occur. The possibility of the mere coincidence of occurrence must be remembered. The fact that such a disease as locomotor ataxia does develop after injury to the back does not establish a causal relation. Each case must be individually considered before any such conclusion can be arrived at."

INFREQUENCY OF SPINAL-CORD DEGENERATION IN BACK SPRAINS.

Page, in summarizing concerning the ultimate liability of the spinal cord to take on degenerative changes incidental to the infliction of back sprains and twists, says: "While then the victims of railway collisions are not by any means exempted from liability to suffer from any and every form of lesion of the spinal cord and its membranes, accumulated experience leaves no doubt that these grave results are most uncommon. Though especially prone to suffer in this form of accident, it is the entire spinal structure which, in ninety-nine cases out of a hundred, bears the brunt of the violence, and suffers from it. Such is the immediate consequence; but in every medico-legal inquiry the future as well as the present has to be considered. What is the prognosis, and what risk is there that after the receipt of some such obscure injury of the back as we have been dealing with, there shall supervene, as a consequence of the injury, the symptoms of degeneration of the spinal cord? No more vital question can be asked in treating railway injuries. It has from the first engaged my very careful attention; and I have endeavored to learn of cases where there has been degeneration of the spinal cord as a remote consequence of spinal injury. My inquiries have either been singularly unsuccessful—and they have been made by direct oral and written communication with many professional brethren in all parts of the country—or it must be admitted that secondary and remote degeneration of the spinal cord in cases where there has been no distinctive form of injury is very rare indeed. Nor have I been able to discover any ground for thinking that the injured in railway collisions, numbering many thousands since the first accident happened, have afforded a larger proportion of these degenerative system diseases of the spinal cord, which in recent years have so much engaged the attention of neurologists and pathologists, than those who have not been exposed to the same influence. It is perfectly true that in some recorded cases, the onset of a system disease has had no more obvious cause than injury, and there is nothing inherently improbable in such a sequence of events; but cases of the kind are wholly exceptional, and too few in number to call for the introduction of any account of them in a chapter devoted only to the calm and every-day forms of spinal injury as seen after collision accidents."

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[1] London Lancet, August 12th, 1893.

SOME OTHER CAUSES IN THE PRÔDUCTION OF FUNCTIONAL TROUBLES BESIDES TRAUMA.

It will be seen that we have attempted to draw a line between cases which are plainly the resultant of physical causes and others having psychical causes. We do not believe that there is any sharply defined type of disease which can be properly called traumatic neurosis; but we do sincerely believe that there are many cases which are dependent entirely upon the force and condition which are created; and, in addition thereto, that the purely pyschic conditions produced by traumatism are separate and distinct from those depending entirely upon physical condition. While realizing that, owing to the by-play of extraordinary circumstances, trivial injuries, particularly with the back symptoms, can readily shade themselves into neuroses, yet we naturally believe that racial differences, perfection of physical condition, and the multiplex force of surroundings are constantly modifying factors. We believe that favorable surroundings and the influence of an unprejudiced and thoroughly impartial medical attendant will be productive of the exact condition of trauma as it exists. And if trauma produces a condition similar to hypnosis, as in traumatic hysteria, we cannot help believing that the existing force and predetermined mental condition of the medical attendant will oftentimes change trivial conditions into serious ones. It seems rather startling that the physician, by virtue of mental superiority, prejudice, and suggestion could create an essentially serious condition; but we candidly believe that it is possible in a weakened and receptive mind to suggest and develop consequences of a very serious nature. And if, as claimed by authority, such cases have been cured by hypnosis, it certainly seems natural that hypnotic suggestion would have equal effect in their causation when the conditions are favorable to it. There cannot be any doubt, if I may so use the word, that traumatized minds absorb sensations not only directly from the effects of the injury, but also receive impressions produced by the suggestions of an already convinced mind; as exemplified in the description of cases given. Any case treated by Oppenheim, where the mind was in an hypnotic condition, certainly would partake of the character of Oppenheim's suggestion. We cannot believe that there is a typical complex of symptoms in every case possessing anything like uniformity; but the local trauma aids to develop the neurosis dependent upon predisposing central disturbances and peculiarities. But where we have physical perfection and mental strength, trauma is very rarely likely to produce the pyschic condition peculiar to traumatic neurosis. For we find that where intelligence is blunted, where surroundings have made incidental elements of danger familiar, physical injuries are manifested as physical injuries, and very rarely terminate in psychic troubles unless there exist extremes in intensity and a predisposition upon the part of the individual, be it either racial, inherited, or acquired.

HÆMATURIA ARISING FROM BACK INJURIES.

Hæmaturia occurs[1] not infrequently incidental to contusions and sprains of the back, generally from severe contusion, strains, or wrenches of the lumbar region. To the laity the appearance of blood coming from some organ within is a source of great fright, and begets an anxiety upon the part of the injured individual seemingly proportionate to his intelligence; as we have seen slight hæmaturia produce such an effect. In one instance a locomotive fireman, on descending from his engine, lightly struck, as he said, his side upon the iron footstep. In a couple of hours, having discovered blood in his urine, he became an utterly shocked, relaxed, and fainting individual. This same man could have unflinchingly lost probably many times the amount of blood he had seen come from him if the source had been plainly indicated. He would neither have fainted nor presented any evidence of shock if he had received a blow in a combat, causing epistaxis; and such a hemorrhage might have been profuse and still not have worried him. Blood from an unknown source, and the fear of bleeding to death, always have their effects.

POSITION OF KIDNEYS A PREDISPOSING CAUSE OF INJURY.

Lidell thus plainly and eloquently discourses regarding the kidney: "It will be remembered that the kidneys are two dense and rather brittle glands which lie close to the sides of the spinal column from the first to the third lumbar vertebræ inclusive, and outside of the peritoneum; that they are surrounded and held in place with considerable firmness by connective tissue containing much fat; that the right kidney projects downward below the last rib, and behind is covered with the quadratus lumborum muscle. Hence all violent flexions of the upper lumbar vertebral articulations, from sprains or wrenches, are liable to be attended by corresponding bends or breaks of the kidney; hence also the impact of powerful blows on the lumbar muscles may readily be transmitted through these muscles to the kidneys themselves with enough force to contuse or even tear those organs. Finally, the renal lesion, in the cases where it consists merely of contusion, or of slight rupture, or of contused laceration of the renal substance, is usually attended by hæmaturia."

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[1] Hæmaturia (*aima*, blood; *ouron*, urine) blood in the urine. Called also hæmaturesis. It is due to injury, local disease, general disorder, or the presence of entozoa, and to the influence of certain remedies.—Gould's Medical Dictionary.

GENERAL CAUSATION OF HÆMATURIA.

When any predisposing cause exists, such as the presence of renal calculi, or where congestive conditions have rendered organs diseased, slight injury is oftentimes accompanied with hæmaturia. It at times becomes, owing to presence of hæmaturia, necessary to determine the source of blood in the urine, since renal colic and the movement of stone from the kidney downward, tumors of the kidney, urinary tuberculosis, and hæmaturia stands in relation to this phase of the disorder as hæmoptysis does to pulmonary phthisis. Injuries, tumors of bladder, certain kinds of food (owing to the idiosyncrasy), malaria, entozoa, excessive use of certain medicines—all are causes of this symptom. Hence it becomes a matter of importance at times to determine the source of blood; whether it is incidental to and consequent upon the injury, or whether we have systemic conditions, dietetic or medicinal causes, or whether it arises from the presence of stone or tumor in the bladder, or some diseased condition of bladder or prostate gland.

MEANS OF DIAGNOSTICATING HÆMATURIA.

Mr. Hilton says, "In examining blood in the urine, swim out in water all clots whose origin is doubtful, in order that you may see their shape. Over and over again you will find yourself able to diagnosticate the case by this simple common-sense experiment."[1]

Hæmaturia incident to contusions and sprains can be determined by a most conclusive evidence furnished by the microscope. Thus, where casts of the uriniferous tubes are discovered. Blood coming from the kidney is usually so intimately mixed with the urine as to give the latter a smoky appearance. When we have hemorrhage coming from the bladder or prostate gland, from tumors, stones, etc., blood always follows micturition; that is, the order of things is reversed. Instead of coming first, as with hæmaturia, it always comes last in the conditions mentioned. Hæmaturia should not be confounded with hæmoglobinuria, a paroxysmal or toxic affection in which the urine contains, not the blood corpuscles but their coloring matter, namely, hæmoglobin in solution.[1]

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[1] Guy's Hospital Reports, 1868.

PROGNOSIS REGARDING ULTIMATE EFFECTS OF HÆMATURIA ON KIDNEYS.

It is hardly necessary to specify the various causes, beyond what we have already done, productive of hæmaturia. What concerns us most in the consideration of this subject is the prognosis, or the ultimate effects of these injuries. Suffice it to say that writers almost universally maintain that it is very rarely a dangerous symptom, as it generally disappears after a few days without leaving any apparent effect of organic disease behind. Thus, for instance, Legros Clark avers that after having witnessed many cases of hæmaturia arising in consequence of traumatism inflicted upon the kidney from this source, he has never had any reason to suspect that nephritis or organic disease followed. Mr. Shaw,[2] who has written very exhaustively upon this subject, makes the following remarks: "When such an important gland as the kidney has been crushed and broken to such an extent that hemorrhage goes on, from a rent in it, for several days, it might be thought probable that the damage would be followed by ulterior bad results; especially that nephritis would ensue. But extended observation negatives this view. General experience shows that when patients recover from the immediate effects of hæmaturia brought on by sprain of the spine, they are not more prone than others to renal complaint."

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[1] Under certain circumstances it may be necessary to absolutely determine the presence of blood, as it is not considered safe to depend upon inspection alone, inasmuch as hæmoglobin in solution simulates the raw meat color of the ruby red as found where blood is mixed with urine. Spectroscopic examination can be used; or Heller's test, where the urine is treated with caustic potash and boiled. The basic earthy phosphates are then precipitated, and together with them the hæmatin derived from the oxyhæmoglobin present. The phosphatic sediment is consequently colored a bright red. Should it happen that the urine contains abundance of coloring matter—bile pigment—which renders it difficult to appreciate the color of the sediment, the latter should be separated, filtered, and dissolved in acetic acid. The solution then becomes red if blood be present, and its color vanishes gradually on exposure to the air. Rosenthal applies the test for hæmin directly to dried precipitant.—Professor v. Jaksch, "Clinical Diagnosis."

[2] Holmes' "System of Surgery," second edition, vol. ii.

Again, frequent evidences are found at post-mortem examinations of wounds that have been inflicted upon this organ, presenting perfect integrity of repair, naturally in consequence of the subcutaneous nature of the injury; where if microbic causes could produce change they certainly do not seem to be intense, and do not, or rarely, lead to inflammatory sequences. Our own experience does not indicate that ultimate troubles follow these injuries. All authors seem to indicate that these conditions are not generally very serious unless we have absolute rupture of the kidney. In the etiology of Bright's disease, while it is recognized that traumatism may produce its initial stage, yet we do not know of a single instance of its production where a previous history plainly indicated its non-existence; nor have we seen a case in consequence of this condition where its production was immediate. We know that the slightest causes are aids in its production; yet, at the same time, we have no recorded instance where, immediately after receipt of injury, evidences were found which plainly indicated that the trauma was the immediate cause of parenchymatous nephritis.

ILLUSTRATIONS OF CASES WHERE TRAUMATISM PRODUCED ULTIMATE EFFECTS.

Odin mentions a case of acute nephritis following eight months after abdominal injury. After the occurrence of the injury, symptoms of renal contusion were quite apparent; among them, hæmaturia, which persisted for four days, and intense pain and difficulty in micturition. When the length of time intervening between the receipt of the original injury and the time when the pathologic condition developed is considered, is it not possible that other causes than traumatism were at work? May not microbic predisposing effects have made themselves manifest? Or, again, might it not be possible that previous traumatic effects were simply renewed and produced in consequence of some new but slight injury inflicted? Roussel, at St. Etienne's Hospital, mentions a case where traumatic trouble occurred in the kidney in which hæmaturia existed, pain and difficulty in micturition occurred. The case was treated in the hospital, and apparently cured; no albumin in the urine. Nine months afterward, as it was claimed, without having been exposed in any way, and without any imprudence, he returned with all the symptoms of acute Bright's disease. Here again we have a case where months intervened; where a history was plainly not kept up in the mean time; and where causes before cited might have had full sway. Again, according to the views of Herzog, indirect violence to the kidney always involves the hilum of the organ; while direct violence leads to laceration of the organ itself. This would certainly seem natural, as direct and concentrated force undoubtedly would seem more competent to produce laceration of the organ.

In a case where an individual was struck upon the small of the back by the lever of a hand-car, hæmaturia appeared; but the amount of blood passed was very moderate. He never recovered from shock, and died some eighteen hours after the injury. Upon post-mortem examination a large ragged tear in the left kidney, almost severing the organ, was found. The amount of blood passed in this case, as stated before, was extremely small, which was clearly explained by the post-mortem. The blood effused into the abdominal cavity extended below the kidney, almost filling the pelvic cavity. The peritoneum was ruptured, which is extremely rare.

MEDICO-LEGAL CONSIDERATION OF HÆMATURIA PRODUCING ALBUMINURIA.

The point which specially interests us is the medico-legal relations of hæmaturia from sprains of the back. Thus, Lidell,[1] in speaking of the medico-legal relations of hæmaturia, cites the following case:

> "Mr. Shaw relates the case of a gentleman who claims in a lawsuit compensation from a railway company for Bright's disease resulting from injuries received in a railway collision. The injuries consisted of a bruise over the right ilium and side of the loin. On the following day, he observed blood mixed with his urine; and for four days he

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[1] *Loc. cit.*

continued to pass blood. At this time his urine was found to contain albumin, and it continued to be albuminous from the date of the accident to that of the trial, a period of eleven months. The medical witnesses for the plaintiff held that the albuminuria, that is, parenchymatous nephritis, had been caused by the injury of the right kidney, which was afflicted in the collision. The medical witnesses for the defence—Mr. Shaw was one of them—expressed a strong opinion that the plaintiff was suffering from a disease when he met with the accident, and that the injury could not have brought it on. But to say that the injury could not have brought on the disease in this instance is tantamount to asserting that a traumatic lesion of the kidney, which manifests itself in hæmaturia appearing on the day following the accident and continuing for four days, cannot give rise to structural disease of the kidney of an inflammatory character. . . . There is, therefore, no reason for doubting that in at least occasional instances the injury which causes hæmaturia gives rise to Bright's disease. In the case just mentioned the jury, notwithstanding the medical testimony adduced by the defence, awarded heavy damages to the sufferer; and it may well be that the verdict was a righteous one. A legitimate inference from the foregoing, which has value for medico-legal uses, is that although some surgeons of large experience have never seen a case in which inflammation from contusions and sprains of the back was followed by nephritis or by organic disease of the kidney, nevertheless such cases do sometimes occur; and that whenever they do occur their existence ought to be recognized. It is also pretty certain that Bright's disease does not often arise from lesion or traumatism, but precisely how often, future experience alone can determine."

In the case herein cited the antecedent history of the individual was not given; and there is no proof presented that this person did not have albuminuria at the time or even before the injury was inflicted. Admitted that the burden of proof was placed upon the side of the defendant, and that the plaintiff was not supposed to testify against himself, still the mere fact of its not having been discovered does not inevitably make it so; for this disease may and does frequently exist before its diagnosis has been made.

Again, for years past, M. Dieulafoy has, both at the bedside and in his much-read work on Medicine, sought to emphasize the importance of divers symptoms which, though often apparently trivial, are none the less significant of the existence of that very common malady, Bright's disease. To these symptoms he has given the name of "petite urémie," Brightism. He regards albuminuria as an unreliable symptom of Bright's disease (the London *Lancet*). In sixty cases under treatment in his wards during recent years, albuminuria was absent in one-fourth. That nephritis really existed was proved in several instances by post-mortem. In another series of cases, albumin disappeared in spite of the continued evolution of the disease. Some patients are albuminuric without being Brightic, to adopt the French expression.[1]

Hence we cannot see wherein this verdict was a righteous one. Suppose that the assertions made by Mr. Shaw were tantamount to asserting that traumatic lesion of the kidney, which manifested itself in hæmaturia appearing on the day following the accident, and continuing for four days, cannot give rise to structural disease of the kidney of an inflammatory character, still we have no proof of its immediate production.

Infrequency of Ulterior Results.

The mass of evidence has shown for many years that ulterior results have been of great infrequency; that the prognosis is good; and that even under the most unfavorable circumstances a serious consequence is of extreme rarity. We know of no instance, excepting the one above cited, where traumatism and the attendant symptom, hæmaturia, were productive of, and immediately the cause of, Bright's disease. There can be no doubt that traumatism may ultimately occasion this trouble; as instanced in the following case, where a consecutive history was obtained, the patient being under constant treatment, and his condition daily watched:

J. M., a switchman, aged 22, was rolled and doubled up under the sand-board of an engine. When brought to the hospital all the evidences of excessive shock were manifest: pale, cold, clammy skin; husky voice; brilliant eyes; rapid, weak pulse; retention of urine. He had vomited several times since the injury. Knowing the limited space in which he was injured, we expected to find fractured and dislocated vertebræ, or injury to the viscera contained in the abdomen; but we failed to find such conditions. He complained of pain in the back, and a numb sensation in his legs which was fitful; no evidence of paralysis, either of motion or sensibility. Upon examination we found the spinous processes of the twelfth dorsal and first lumbar vertebræ out of line and slightly separated, plainly due to a subluxation of the vertebræ of limited extent. There was little or no bruising on the back, but he was plentifully bruised upon the extremities. After the inflammatory symptoms had subsided, a plaster jacket was applied. The urine was scant. It was examined at various intervals after the patient was able to be up and around. He continued to complain of more or less pain in the back—improved. Cast was changed for a leather jacket. In the third month, the urine was examined and found to contain slight evidence of albuminuria. The urine was watched daily from this time on. A month after, tubular casts were manifested under the microscope; anasarca gradually developed, with puffy eyelids, etc. This continued for nearly two months, but under treatment all evidence of albumin gradually disappeared, and eight months after injury he was able to resume his vocation. The urine has been examined many times since, but there has been no return of the trouble. He has been constantly at work for the past two years, and presents all evidences of being in thoroughly good health. In this case, while injury to the kidney was not indicated by the presence of hæmaturia, yet there can be no doubt, taking into consideration the manner in which this individual was injured and the limited space in which he was confined at the time of injury, and the extreme flexion of the spinal column, that the kidney was injured at the time.

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[1] Medical Review, November 18th, 1893.

Another case, where the individual received a heavy blow on the right side of the back and loins, and where hæmaturia immediately appeared, under rest and treatment progressed to recovery without interruption. But the patient returned to the hospital some eight months afterward suffering from malarial complications. Albumin was discovered in his urine; under microscope no casts were discovered. Upon treating the malarial troubles, the albumin disappeared. Probably the influence of malaria had as much effect in producing the trouble as the injury, but it was transient in any event.

CONCLUSIONS.

It cannot be doubted that organs, particularly the liver and kidney, are subject to traumatism of a positive and undoubted character, and that these internal injuries seem to heal with unusual rapidity, owing to their subcutaneous character. While realizing that scar-tissue is neoplastic, and is generally nature's completest repair, and that it can in no way be called normal tissue, and that under the many adverse conditions in which man is placed this tissue is easy to break down and be the focus of lesion, still when thorough investigation of these injuries is made, particularly as regards the kidney, a marvellous healing power is manifested, and the very infrequent occurrence of adverse conditions indicates the perfection of nature's reparative processes.

There is a natural tendency upon the part of the physician to deal in that which is remote or speculative, assuming oftentimes that what is extremely improbable will naturally follow; hence there is only one element upon which anything like a proximate and correct estimate can be drawn, and that is the accumulated experience of the profession, where years have shown results. There oftentimes arises, in consequence of a lack of the honesty which should characterize the physician, an utter indifference to the results to either corporations or individuals. Hence, while any physician might truly assert that hæmaturia arising incidental to the infliction of an injury to the kidney might be productive of ulterior results, yet such instances have been shown to be so infrequent that they are only of the nature of mere coincidence.

CHAPTER III.

RAILWAY INJURIES AND CONSEQUENT FUNCTIONAL DISORDERS, WITH AND WITHOUT LESION.

INCIDENT TO RAILWAY ACCIDENTS.—COMPRISING A CONSIDERATION OF TRAUMATIC NEUROSIS, TRAUMATIC EPILEPSY, TRAUMATIC INSANITY AND LOCOMOTOR ATAXIA.

1st. History and evolution of traumatic neuroses.—2d. Why the term traumatic neuroses is used.—3d. Power of trauma or injury as a cause in producing disease.—4th. Fear as a cause of psychic trauma.—5th. Differences definitionally between hysteria and neurasthenia.—6th. Psychic conditions immediately after railway injuries.—7th. Initiatory symptoms of traumatic neuroses.—8th. Insomnia—Its relative meaning and application.—9th. The appearance of psychic or mental changes.—10th. Seeming loss of memory.—11th. Inability to concentrate attention or indulge in brain use.—12th. Involvement of speech.—13th. Implication of sensation and of special senses.—14th. Disorders of motility.—15th. Hemianæsthesia, gait and hysterical contractions.—16th. Characteristic gait-disturbances of this condition.—17th. The hysterical joint occurring in traumatic neurosis.—18th. The part enacted by motor and sensory paralysis.—19th. Functional nervous symptoms arising from railway injuries not due to hysteria alone.—20th. Tremors—Their disappearance at times not indicative of simulation.—21st. Tendon reflexes—Superficial reflexes.—22d. Other troubles of motility.—23d. Disturbances of the circulatory system.—24th. Digestion and general nutrition.—25th. Genito-urinary symptoms.—26th. The sexual functions.—27th. A consideration of Erichsen's "Spent Shock" when compound lesions or simple lesions are produced.—28th. General consideration regarding the classification of traumatic neuroses.—29th. A consideration of head injuries, conducive particularly to traumatic epilepsy and traumatic insanity.—30th. Traumatic epilepsy.—31st. Traumatic insanity.—32d. Traumatic locomotor ataxia.

HISTORY AND EVOLUTION OF TRAUMATIC NEUROSES.

GRAY most expressively says: "The clinical phenomena of hysteria are as varied as the phenomena of the cerebro-spinal and sympathetic nervous system, and of these may be said, what

Shakespeare said of Cleopatra—who probably charmed Cæsar by her very hysteria—that:

> " 'Age cannot stale, nor custom wither
> Her infinite variety.' "

If this quotation, so pleasingly expressed, suggests the multiplicity of symptoms arising from hysteria, even more would it apply to traumatic neurosis, whose varied phases seem to change according to the race affected. In its symptoms hysterical elements predominate in France, while neurasthenic elements of seemingly varying intensity predominate in Germany, England, and this country, if we may depend upon the descriptions given. The morbid syndrome designated, during various periods of its history, as cerebro-spinal concussion, spinal concussion, railway brain, railway spine, traumatic hysteria, traumatic neurasthenia, was originally described as a result of observations incidental to and consequent upon injuries inflicted upon railways. For nearly thirty years there have been careful study and analysis of the characteristics of traumatic neurosis, and they have been brought into correct relation to pathology. So much has been said and written regarding the relative merits of various theories concerning traumatic neurosis that it will be more profitable to give the present accepted ideas concerning this trouble than to discuss the various theories at length.

Mr. Erichsen was the first to fully direct the attention of the scientific world to this condition; he first classed the various symptoms arising from these injuries as due to spinal concussion, and from his description and views sprang the term "railway spine." In the subsequent study of the condition it appeared that many of the symptoms were cerebral rather than spinal. The condition, as completely described by Erichsen, partook of the nature of a chronic meningo-myelitic trouble. In the studies made by Putnam, Walton, and Oppenheim, the brain was emphasized as the source of trouble, more than the spinal cord. Then originated another contracted and indefinite term called "railway brain." In the mean time, Charcot having demonstrated the identity of hysteria in the male with that of the female, this discovery exercised its influence through the Charcot school, which claims that hysteria[1] provoked by acci-

[1] Putnam, in the Boston Medical and Surgical Journal of September, 1883, says, "The question often arises with jury trials what attitude

dent is the source of certain nervous troubles, such as paralysis, hyperæsthesias, anæsthesias, and contractures; and Charcot still further demonstrated that after traumatisms nervous troubles frequently arise which may produce a condition essentially the same as that induced by suggestion in persons capable of being hypnotized. Finally, Oppenheim, Strümpell, Knapp, and others averred that a traumatic neurosis was more of a neurasthenic than an hysterical condition; that in consequence of its fixedness, tenacity, and the combinations of peculiar mental states, it bordered on the psychoses partaking of the nature of melancholia and hypochondria. Such conditions they designated traumatic psychoses, and local and general neuroses.

WHY THE TERM TRAUMATIC NEUROSIS IS USED.[1]

The term "traumatic neurosis," broadly interpreted, means an abnormal nervous action, or an affection of the nerves or nerve-centres of a functional nature, due to traumatism.

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should be taken toward the term hysteria. Senseless as the designation is, it has to the popular and scientific mind two different but pretty definite meanings. To the former it is almost a term of reproach, and suggests exaggeration, if not half-conscious simulation. Its pains and palsies are considered to be only mimic ailments which an effort of resolution would dispel. The expert knows, however, that this view is only, of course, half truth; that, in fact, hysteria, in some of its simulations of other diseases, presents only, in reality, similarities. The former or belittling view of hysteria is the one, of course, usually taken by the counsel for the defence; but if the patient really has hysteria it is certainly better that the fact be recognized by both sides, and opportunity claimed for explaining the nature of the disease, than that the prosecution, shunning all mention of the true diagnosis, should darkly hint at possible organic lesions, leaving it to the defence to bring forward the obnoxious word, and using it as a synonym for exaggeration, womanishness and deception. The opinion should not be allowed to prevail that hysteria is only a mimetic disease. For to the mind of those making this statement in court, the designation carries with it a flavor of unreality and insignificance. The paralyses of hysteria are no more mimetic of the organic paralysis than the reverse is true; or than the cough of bronchitis is mimetic of the cough of phthisis."

[1] Thus, for instance, W. Thorburn, in a contribution to the Surgery of the Spinal Column, referring to the reason why he uses the term "traumatic hysteria," in the place of traumatic neurosis, says, "I employ it because it appears to me highly inadvisable to replace old names by newly coined ones unless the former be distinctly objectionable. Hysteria is by some regarded as inadmissible on account of its etymology, its original significance, and the erroneous theory which it implies. But we have now finally escaped from all danger of being misled by the older views. Hysteria no longer connotes any theory, and in the present imperfect state of pathological science it is often better to use meaningless words, rather than such as imply a theory which may turn out to be wrong. Extremes here meet, and a word which means nothing and a

is combined with mental shock; and this is particularly frequent in the case of railway injuries.

FEAR AS A CAUSE OF PSYCHIC TRAUMA.

It was Montaigne who said, "The thing in the world I am most afraid of is fear, and with good reason; that passion alone, in the trouble of it, exceeding all other accidents." Had this been said after a railway collision, it would have very keenly and closely indicated the dangerous element of mental traumatism arising therefrom. For, indeed, many collisions which occur upon railways are of such nature that the sheer intensity of circumstance makes them productive of all the degrees of this passion, as expressed by the words fear, dread, terror, and consternation. The crowded limits and changed surroundings of a passenger coach; the sense of rapid and powerful motion, with its sudden interruption; the sight and sound of destructive forces; at times, the complete subversion of all the normal elements of gravity; the depression of surroundings; the consciousness of immediate encompassment; the intense dread of impending and unknown danger; the seemingly hopelessness of escape; and finally the mental depression engendered by the sight of injured and dying human beings—all these things certainly seem competent to produce the profoundest mental depression.

PSYCHIC CONDITIONS IMMEDIATELY FOLLOWING RAILWAY ACCIDENTS.

Thorburn[1] says: "It is commonly found that the victims of railway accidents have passed through a more or less brief stage of what they call unconsciousness. This is not the ordinary unconsciousness of concussion of the brain, and it is unaccompanied by any of the usual symptoms of the latter condition, vomiting, relaxation of the sphincters, etc. The condition is rather one of general obliquity to external impressions, in which many voluntary acts are performed almost automatically, the higher mental faculties alone being in abeyance. Such a state resembles much more closely the hypnotic condition. The injured person may get up and walk away, taking little or no troubles arising therefrom make up the greater part of medicine. As Gray[1] remarks, "Existing medical knowledge will not permit us to say that there is any one disease of the human body that cannot possibly be caused by injury, except possibly one of an infectious nature. . . . Predisposition, whether hereditary, or from previous diseases, or from coexisting diseases, may render the human being more liable to the excitation of disease by injury; and it may then become a question as to the respective responsibility of the injury and the predisposition in the production of the disease."

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[1] "A Contribution to the Surgery of the Spinal Cord," by Wm. Thorburn, B.D., B.Sc., M.D. (Lond.). Blakiston, Son & Co., Philadelphia.

THE DIFFERENTIATION OF HYSTERIA AND NEURASTHENIA.

Before attempting a full consideration of this subject, and inasmuch as the medico-legal consideration of it has to face the important question as to whether the phenomena manifested in the course of traumatic neuroses are of an hysterical or neurasthenic nature, it will not be out of place to define, according to existing literature, the differences which distinguish hysteria and neurasthenia. Thus, according to Hirt,[2] "hysteria has this in common with neurasthenia, that it does not depend upon any demonstrable lesions of the nervous system; but it differs from it in the fact that for its development a certain predisposition on the part of the patient is absolutely necessary. The exact nature of this predisposition has not been determined." Neurasthenia, meaning nervous prostration or exhaustion in the subject under consideration, arises from trauma. While neurasthenia and hysteria are distinct, at times they are often found in combination; and hysteria may be combined with neurasthenic symptoms. Both neurasthenia and hysteria may be caused by traumatism, where the injurious influence acts both physically and psychically. Psychical traumatism may appear under conditions extremely variable. The influence exciting it may act immediately, or gradually and subdolously. Such causes are excessive fright, intense anger, great grief, extreme humiliation, profound and continued anxiety, constant worry. Again, we have conditions where physical

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[1] "A Treatise on Nervous and Mental Diseases," by Landon Carter Gray, M.D. Lea Brothers & Co., Philadelphia, 1893.

[2] "The Diseases of the Nervous System," by Ludwig Hirt, M.D. D. Appleton & Co., Pub., 1893.

After a time he finds that he has become nervous; that he is thoroughly restless, and unable to sleep; that his work has become irksome or a positive burden; that it is extremely difficult or seemingly impossible for him to concentrate his mind; that he is easily frightened, and thoroughly irritable; and from this time on there quickly follow those peculiar mental states bordering on melancholia and hypochondria.

INSOMNIA—ITS RELATIVE MEANING AND APPLICATION.

With the development of these peculiar mental conditions comes a multitude of other symptoms. All authors agree that in patients affected with traumatic neurosis insomnia is frequently manifest, a symptom seemingly dependent at times upon the harrowing nature of the accident. In the descriptions given by such sufferers, as Oppenheim says, "Insomnia is not meant so much as wild dreams, for which the event of the injury affords material; or restlessness and broken sleep. This may be objectively ascertained by those who cannot rest owing to the sighs, restlessness, muttering, or screams of the sufferer. Sometimes there is great agitation or fright during the night; the patient is compelled to leave his bed and run around the room. Others say that they only half-sleep. What they have done during the night they may not remember or be able to recite, through having been unconscious." Again, if an individual has undergone psychical shock, and is still able to sleep, certainly this shock cannot be considered as in any way seriously affecting him; for sleep plainly indicates a normal condition. We are frequently able to prognosticate the recovery of a patient if during convalescence there is ability to sleep.

THE APPEARANCE OF PSYCHIC OR MENTAL CHANGES.

Mental changes once manifest, the patient becomes pathologically egotistic. He thinks only of his injury; becomes very moody; studies his pains; and draws dismal and exaggerated pictures of his helpless condition, anticipating the future with a constant, deep-seated dread. He becomes reticent and apathetic, and avoids company—a deepening gloom enshrouds his face, and furrows it with wrinkles expressive of his psychic state. His voice changes. He takes no interest in anything about him, and loses all interest in his present and future.

Withal, he becomes thoroughly irritable. "The increased impressionability which follows extreme irritating causes compels the patient to seek loneliness. They state that they feel infinitely better when utterly alone" (Oppenheim).

SEEMING LOSS OF MEMORY.

This "analogous monomania" leads to a seeming loss of memory, due undoubtedly to impaired nutrition of the brain. But, as averred by Page, it does not indicate any serious troubles in connection with that organ, but merely a condition of cerebral malnutrition. There is an inability to concentrate thought and attention, which is due entirely to general weakness following the injury to the nerve-centres produced by traumatism; for it is well known that memory exists to a degree that permits such sufferers to give dates and incidents with unusual clearness, particularly regarding the occurrence of the accident.[1]

INABILITY TO CONCENTRATE ATTENTION OR TO THINK.

Along with this condition of brain fatigue resulting from imperfect nutrition of the brain and the system at large, there is naturally diminution of the power of giving close attention, and more or less inability to concentrate the mind sufficiently to engage in conversation. Such a sufferer is compelled to refrain from reading and writing; and with any endeavor to follow his usual vocation the poorly nourished individual discovers his inability to do anything requiring brain activity, particularly where concentrated attention and thought are necessary.

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[1] The recollection of the accident is extensively animated. It imprints on the sentiments an altogether peculiar character, and provokes, on account of the most trivial causes, a kind of unconquerable anguish, even a real paroxysm of fear. "Often," says Vibert, "I have purposely provoked muscular trembling by dwelling in the conversation with the patient on the details of the accident. At a certain moment I would see the lips and facial muscles take on fibrillary movements; then the trembling would affect the hands, and sometimes extend over the rest of the body. Some would be startled at a sudden noise; others would weep at the recollection of the accident; still others, in order not to hear it spoken of, would seclude themselves alone." As M. Bouveret has it: "There is already present an outline—or foreshadowing—of neurasthenia, or even a kind of neurasthenic state. These nervous troubles may only last some days, and then disappear entirely; or, indeed, with or without a period of amelioration, they persist, become aggravated, or even become established in a lasting manner."—Dr. Claude Guillemand, *loc. cit.*

INVOLVEMENT OF SPEECH.

It is averred that it is rare in this condition to find but one cerebral nerve involved; more frequently we have the entire motor areas involved.

It is a remarkable fact that aphasia has never manifested itself in any of the numerous cases that have come under our personal observation. Aphonia has occurred, in our observation, and it is constantly mentioned by authors; but it is generally transient in character, and seemingly essentially the same as that found in hysteria. In one case which we had under treatment this symptom persisted nearly three months, and at the time it was considered a pure case of simulation. The patient was under constant and unceasing espionage, and there never was a moment during the entire time when the patient was thrown off his guard, or gave any evidence of being able to speak above a whisper. Laryngoscopic examinations were made, and the organs of voice were found in a perfectly normal condition.

The variations as regards speech seem especially to mimic the peculiarities of the individual. At times an unusual effort upon the part of the patient seems only to be productive of delayed and halting utterance; or there may be simply a slowing of the speech. Again, words are explosively uttered, and during these times we not infrequently have observed rapid, panting respiration. In such cases there is every evidence of the existence of a truly neurotic condition, which seems capable of being intensified and fixed by repeated medical examinations.

Upon one occasion where we employed a determined quick and impatient tone of voice, we were met with a stuttering, which seemed to grow more pronounced as we confused our patient by rapidity of demand. It has been asserted that there is nothing about these disturbances of speech which point to a true paralytic form of trouble, but that they are entirely dependent upon the coexisting weakened condition of the patients.

IMPLICATION OF SENSATION AND OF SPECIAL SENSES.

Pain is one of the most constantly occurring symptoms in this neurosis. Pain is at all times a relative and indefinite quantity, and there are no positive means at our command to either measure or determine it. Where we have a general concussion of the economy, pains are mostly found in the lumbar and sacral regions, seemingly dependent at times upon the part hurt. Headache is of varying intensity and character. The patient complains of a disagreeable pressure in the head, which is frequently accompanied with feelings of dizziness. Again, headache may be entirely suboccipital; or it may be confined to one side of the head, resembling hemicrania. It may be increased either by physical or mental exertion; and it is not dependent upon neuralgic, but upon neurasthenic conditions. Paræsthesiæ are of various kinds, and are inconstant phenomena though rarely absent. Hyperæsthesia and anæsthesia affect various parts of the body. Cutaneous anæsthesia affects irregular areas of the back, and its seat is often dependent upon the locality of the trauma. And as Hirt[1] says, "Even a pronounced hemianæsthesia hysterica extending over the head, neck, and upper part of the chest (so-called doll's-head form)," is often demonstrable clinically, which varies with regard to its seat and extent in the same individual so much that frequently repeated examinations will give different results. The hyperæsthesiæ occurring in traumatic neuroses bear no resemblance to those occurring in organic troubles; as has been asserted, they are bounded by straight lines running around the limb or body, or they are more or less sharply defined and separated by the median line of the body. This is also especially true of the anæsthesiæ of this class. Disturbance of the organs of special sense are of constant occurrence. Smell, taste, hearing, and vision may be either dulled, increased, or absent. One particular case is recalled wherein hearing was stated by the patient to be absolutely lost, with diminution of vision, and an absence of both taste and smell. But the presence of hearing was made plainly manifest, though we were unable to detect the existence of either smell or taste. It was found that these conditions varied; that on one day they would be more or less pronounced; on another, dull or absent. "The most constant disturbance is with sight, diminution of the field of vision usually affecting both eyes; but when hemianæsthesia exists it is more pronounced upon the anæsthetic side. The diminution of the field of vision is usually uniform and peripheral, but there may be at times scotomata. Achromatopsia is usually, but certainly not always, present" (Thorburn).

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[1] "Diseases of the Nervous System." Hirt, *loc. cit.*

DISORDERS OF MOTILITY.

Disorders of motility of varying intensity seem almost constant. They consist in some cases of simple fibrillary movements of the facial muscles, or trembling of the arms and hands. In the great majority of cases our attention is called to the back by pain located there, even when other parts have been injured. Rigidity and fixation of the muscles of the back are found, preventing either flexion, rotation, or lateral motion of the spine, as well as either rotation or flexion of the head. These conditions seem to arise from permanent contraction and rigidity of lumbar muscles. The patient can, under volition, increase the extent of motion, but only at the expense of suffering. Either in the act of rising or sitting down, the patient experiences difficulty, using his hands as supports.

A general condition of neuro-muscular asthenia seems to predominate. Functional paralysis is often present, but a true paralysis never occurs. Generally, motor debility is shown on any muscular effort. It would seem that the part injured frequently determines the locality of paralysis. Thus it has been shown that, in the event that the paralysis is hemiplegic or monoplegic, external injuries have been inflicted upon the same side. If an arm has been injured, brachial paralysis follows; similarly in the case of the leg. Oppenheim says that the extent of motor derangement is not exactly equal to the extent of the trauma, but that it rather oversteps it.

HEMIANÆSTHESIA, GAIT, AND HYSTERICAL CONTRACTURES.

In conditions of hemianæsthesia, a circumscribed and halting gait has been considered diagnostic; and Oppenheim makes the assertion that oftentimes trauma produces in an exaggerated degree motor derangements; that almost invariably both upper and lower extremities are involved; or the difficulty may be one-sided. Concerning hysterical contractures accompanied with functional paralysis, Charcot has drawn attention to the fact of their sudden and manifest appearance; and points out that the great degree of contracture prevents passive movements. Deformities caused by contractures seem to be exaggerated. Under certain circumstances trophic conditions may arise, and muscular atrophy may make itself manifest; but as a general thing this is remarkably slow, and when it does occur, it has been stated that we have a diminution of muscular fibres, with other changes attendant.

CHARACTERISTIC GAIT-DISTURBANCES OF THIS CONDITION.

It is not necessary to enter into any extended account of the disturbances of gait. We may observe the short, slow, and laggard step, where the toes, or rather the ball of the foot, do not impress themselves upon the floor normally, but the foot is dragged. When the abnormal position of the body, with its rigid and fixed spinal column, is considered, it would be but natural to suppose that the gait could present none of its normal characteristics. Generally bent forward, with his body fixed, in order to avoid the severe pain incidental to exertion, it is but natural that the patient's motions should be cramped and circumscribed. The various stages of this condition seem to hinge upon the previous normal psychic condition of the individual affected. At times trembling is a predominant feature. These tremors may affect but a certain group of muscles, or, again, they may involve the whole body. In fact, the various pathological gaits are many and varied, and are often seemingly dependent upon the psychical peculiarity of the individual. Oppenheim asserts that "the swaying motion of the body, when the eyes are closed, does not seem to differ from Romberg's symptom of tabes dorsalis."

THE HYSTERICAL JOINT OCCURRING IN TRAUMATIC NEUROSES.

Among the motor disturbances occurring in traumatic neuroses, we meet the so-called hysterical joint, first described by Brodie more than fifty years ago. The knee and hip joints are most commonly affected. There appears to be great local distress, unaccompanied by any swelling or redness, although there may be now and then transient swelling. Pain seems to prevent passive movements, while active motion is next to impossible to accomplish. The parts around the affected joints are generally normal in size, but under exceptional circumstances the gluteal muscles may undergo slight atrophic changes. There is excessive hyperæsthesia of the skin; the slightest touch produces pain, but upon close examination the pain seems not to be confined to one spot, but distributed over varied large areas of the lower extremity. The patient cries out when pressure is made on or near the knee or hip joint, or even at times when pressure is made as low down on the extremity as the malleoli. This pain is seemingly intensely exalted when the patient is watching and noting the progress of the examination; but in the event that the attention of the patient is diverted, well-pronounced pressure can be applied over an otherwise painful area and fail to elicit complaint. In the event that an anæsthetic is used, the excessively contracted muscles around a joint relax, and complete motion of the joint becomes possible. That this trouble is purely of a functional character is demonstrated by the fact that the intense hyperæsthesia is completely lost upon the withdrawal of the attention of the patient, aside from the fact that there is absence of evidence indicative of the degeneration of the muscles which is found in true joint disease; and also by the fact that there is complete freedom of motion of the joint under the influence of anæsthetics.[1] Neuralgic pains in the joints, incidental to this condition, are numerous and very obstinate. It is hardly necessary to enter into any extended account of them; they are regarded as being entirely psychic in character.

THE PART PLAYED BY MOTOR AND SENSORY PARALYSES.

Among the spinal symptoms of traumatic neuroses the most important part is enacted by motor and sensory paralyses. The motor paralyses are usually of a flaccid character, and seem dependent upon the loss of will power; since observation shows that they are not complete. Paralysis may affect one extremity or more. A patient may be able to move an affected upper extremity, but still be incompetent to perform any extended function with that part. When the lower extremities are implicated, though there may be power to move them freely, still, when any attempt at walking is made, complete failure follows. As previously indicated, this condition arises from the fact that the will power is lost; hence the inability to accomplish complicated movements. C. Guillemand says: "Motion is completely suppressed. It seems to the patient that his limbs are inert foreign bodies which he drags after him. Sensibility in all of its forms is completely suppressed, both on the surface and in the deep parts. Cutaneous anæsthesia is generally distributed over the whole limb, sometimes with sensitive areas, more or less separated and more or less extensive. But the sign which, in fact, is characteristic of this anæsthesia is that it is limited by lines as well defined as though these were delineated for doing an amputation." During the whole duration of the paralysis, the tendon reflexes are preserved. The face never participates in the paralysis; when a change of feature occurs it is not due to paralysis but to contractures. Segmentary paralysis is recognized by functional impotence of the parts lying below the affected articulation, and by an anæsthesia equally limited by a line of amputation, or, indeed, lying between two lines of amputation.

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[1] While, as a rule neuromimetic joints yield to proper treatment, there are interesting instances in the literature in which organic change has succeeded the functional disturbance. In the remarkable case reported in Weir Mitchell's Lectures, the hysterical features were pronounced, and on account of the chronicity the disease of the knee-joint was considered organic by such an authority as Billroth. Sands operated and found the joint surfaces normal, and the thickening to be due to non-tuberculous inflammatory products outside the capsules.—"Principles and Practice of Medicine," by Wm. Osler: D. Appleton & Co., New York, 1892.

Hirt mentions in his book on Nervous Diseases that hysterical joints have been known to exist for over thirteen years, and still no organic trouble occur with the joint.

FUNCTIONAL NERVOUS SYMPTOMS ARISING FROM RAILWAY INJURIES NOT DUE TO HYSTERIA ALONE.

Gray says: "Charcot teaches that the sole diagnostic symptom of hysteria may be hemianæsthesia, consisting of one-sided impairment of the senses of touch, temperature, pain, and heat, with impairment of the color sense, and concentric limitations of the field of vision; and around this dictum of Charcot has been waged a furious war. The great French teacher has shown to his classes cases of paralysis involving the arm or leg with a peculiar limitation of the anæsthetic area, and has claimed that they are hysterical in their nature, because the patient also had hemianæsthesia. Oppenheim and Thompson have found, however, that hemianæsthesia may exist in epilepsy, alcoholism, nervousness, neurasthenia, chorea, conditions of fright, multiple sclerosis, Westphal's neuroses, and in organic brain diseases, and also follow certain forms of insanity; and that it is not characteristic of hysteria, in which disease it is variable, bearing no certain relationship to the bilateral condition of limitation of the field of vision, the most constant symptom of hysteria. Charcot's claims, therefore, that the functional nervous symptoms of all cases from railway injury are due to hysteria, therefore, have not been proven."

Tremors—Their Disappearance at Times not Indicative of Simulation.—Tremors have been much discussed, owing to the fact that they disappear at times when the patient's attention has been attracted elsewhere. This peculiarity is entirely dependent upon the psychical condition; and as asserted by Oppenheim, it is not a proof of simulation that cessation of tremor occurs under the conditions mentioned. We find that tremors are generally distributed, very rarely being confined to one extremity or one side.

Tendon Reflexes.—The tendon reflexes, while probably never absent, never present a uniform condition. In some cases they are exaggerated, in others they act but feebly, or the reactions of the two sides may be irregular.

Superficial Reflexes.—While reflexes from the skin and mucous membrane are never constant even in health, still when they are present they are considered by many authors as being of especial value. In hemianæsthesia they are generally absent upon the anæsthetic side. Corneal reflex is rarely entirely absent, the nasal and conjunctival may be entirely so on the anæsthetic side, while the cremasteric and abdominal reflexes are less often absent than those previously indicated. The plantar reflexes are at times more or less modified. As a rule the skin reflexes are increased in hyperæsthetic areas.

Other Troubles of Motility.—Other troubles of motility to be mentioned in passing are convulsions, which of course are purely of an hysterical or hystero-epileptic type, and secondarily dependent upon the intensity of psychical effects. There seems to be considerable deviation in the manifestation of simple motor activity. It is mentioned that in the mere act of protruding the tongue there may be confusion, particularly as regards perfect freedom and co-ordination. It is stated by Page that in some of the worst cases a considerable degree of photophobia is met, but that far more frequently we find asthenopic conditions existing, due to the general weakness of the muscular system; that as a general accompaniment of this muscular weakness and brain fatigue the size of the pupil very frequently alters, valuable evidence of the state of nervous tone. He avers that a widely dilated sluggish pupil is incompatible with a healthy tone of the nervous system, and conversely that a small pupil which readily varies according to the degree of light is a rare accompaniment of exhausted nervous strength.

Though the size and activity of the pupil are always used when endeavoring to estimate the amount of general nervous prostration, there are no constant criteria to guide us. Changes in the deeper structures of the eye are likewise inconstant. Thus, Thorburn says: "From the above summary we are led to the conclusion that the occurrence of optic neuritis is extremely rare in the cases formerly described as concussion of the spine; that vascular changes in the optic disc and retina are not incompatible with the recognized results of hysteria." We have no satisfactory evidence that they were due to lesion of the cord. They are probably functional. Traumatic neurosis may possibly give rise to changes in the optic disc. Prof. Clifford Allbut avers that while he regards the atrophic condition of the optic nerve as possible, it must not be made much of, plainly indicating that this symptom has many of the elements of coincidence. Thus, Page says that "the sufferer from spinal sprain and its frequent accompaniment, nervous prostration, has therefore small cause for anxiety on this point, while at the same time every care must be taken that any pathological changes discovered are not the result, to use Dr. Gowers' words in writing of this very class of cases, 'of an affection of the mind of the observer rather than the eye of the observed.' "

DISTURBANCES OF THE CIRCULATORY SYSTEM.

Much stress is laid upon the influence of this trouble upon the cardiac and vascular nervous system. European authors, particularly those on the continent, enter into long dissertations regarding the peculiar nervous disturbances of the circulatory system, and which they considered of especial value, owing to the fact that the system is not under the control of the will of the patient. Therefore they considered such symptoms to be of great weight in determining simulation in traumatic neurosis. That they play a more or less important part in the inability to sleep and the general functional derangement, there can be no doubt. The occurrence of palpitation is one of the most frequent occurrences of a neurasthenic state. In the first place, as pointed out by Page, the original shock manifests itself in the degree of cardiac paresis produced, notably by the small, feeble, or slow heart-beat. Patients complain of palpitation from the most trifling causes. Page says: "The cardiac innervation may be so distributed as to produce great quickness of the pulse, which may vary from 100 to 150. But far more commonly the palpitation is the occasion of it, and it is only from exciting causes that the pulse-beat is increased. It is important to remember this in the examination of patients: that if you count the pulse only at the beginning of the examination, you may be led to believe that the cardiac disturbance is more serious than in reality it is; and by the opposite error you may fail to discover any cardiac disturbance at all. A perfectly steady pulse throughout the whole examination tells its own tale. Nay, the rate, the character, and the excitability of the pulse form almost a metric indication of the amount of disturbance of the nervous balance, strength, and tone, and the pulse is often the only sign there is to guide us as to the right estimate of the patient's condition." He further says that the whole vasomotor system may be deranged, that there are evidences of disturbances in the peripheral parts of the system, and that they are not necessarily under the same nervous influence as the heart itself. The functional strength of the vasomotor system has been weakened; it has lost its tone and healthy balance. Again vasomotor conditions may exist in the paralyzed extremity. It is occasionally cyanosed, and colder than the healthy side, as indicated by thermometric test. There may be œdematous swelling in parts where will power has been lost, particularly in the lower extremities, as we noted in one case where both extremities from the knee down were cyanotic, cold, and œdematous. Again excessive sweating is one of the accompaniments of this condition. It too depends upon impaired nervous function. Page likewise includes among these symptoms polyuria, menorrhagia, and diarrhœa. These, he avers, are kindred signs of vasomotor disturbances, and in all probability depend upon exhaustion or paresis of the vasomotor centres.

DIGESTION AND GENERAL NUTRITION.

There is marked difference between the opinions expressed by authors upon this subject. Oppenheim says, "Even in severe cases, ability to eat is not disturbed," while Page avers exactly the contrary. Thus, Oppenheim says, "Loss of appetite proceeding to the extent of anorexia is seldom observed in cases of this kind." Page says, "The nausea and even the vomiting which accompanied the early collapse are both prone to continue, and the patient acquires an absolute loathing for food." Again, Oppenheim says, "General nutrition is not markedly affected;" while Page says, "General nutrition is interfered with because of the nervous depression whereby the proper and requisite nervous stimulant is withdrawn from the digestive and nutritive processes." Oppenheim says, "In but a few patients has the emaciation been so considerable as to attract attention; but if we are to believe the statement of patients, decrease of weight often does occur." Again, Page says, "At any rate, marked general wasting is often a striking phenomenon in cases of neurasthenia." The solution to this diversity of thought can be reconciled only upon the fact of differences existing between well-pronounced neurasthenic and hysterical conditions. We quote the following from Guillemand: "We understand only a part of the digestive disturbances; those of intestinal digestion are still almost unknown." Bouveret distinguished two forms of gastro-intestinal atony, the benign form, or that of the first degree, and the grave form, or that of the second degree. What characterizes especially the benign form is the preservation of "embonpoint"—plumpness; nutrition does not seem to suffer. The subjective symptoms may thus be summed up: sensations of weight, sluggishness, and cramps in the belly, feelings of fulness and ballooning of the epigastric region and hypochondrium. Examination of the region after a repast shows the existence of gaseous distention of the stomach. There is meteorism of the epigastrium, and the gastric resonance extends a little beyond the physiological limits. Succussion of the body, or sudden depression of the abdominal wall, produces a clear sound of splashing, but in the first degree of gastro-intestinal atony this sound can be elicited only during the first hour after a meal, and remains localized above the umbilicus.

GENITO-URINARY SYMPTOMS.

Accompanying the general muscular enfeeblement, the marked feature of this condition, there may be partial symptoms in the domain of the genito-urinary system. There may be retention of urine, which makes itself manifest at times in a frequent desire to micturate; and at times retention may be so extreme as to necessitate the use of the catheter, since complete emptying of the bladder is not accomplished. It is averred that at times anæsthesia of the genito-urinary and rectal mucous membranes coexists with incontinence of urine and fæces.

THE SEXUAL FUNCTIONS.

Where neurasthenic symptoms prevail, loss of sexual function is more or less involved. Sometimes there exists simply a decrease of the sexual desire, while more or less power exists; again there may be a decrease in the power, and an increase in desire; or complete impotency may occur. We have no positive proof by which we can definitely determine the presence or degree of sexual impairment. It is asserted that not infrequently spermatic fluid is passed during micturition and defecation.

A CONSIDERATION OF ERICHSEN'S "SPENT SHOCK," WHEN COMPOUND OR SIMPLE LESIONS ARE PRODUCED.

Erichsen, in his work on "Concussion of the Spine," says: "A person who by any of the accidents of civil life meets with an injury by which one of the limbs is fractured or is dislocated necessarily sustains a very severe shock: but it is a very rare thing indeed to find that the spinal cord or the brain has been injuriously influenced by this shock that has been impressed on the body. It would appear as if the violence of the shock expended itself in the production of the fracture or the dislocation, and that a jar of the more delicate nervous structures is thus avoided. I may give a familiar illustration of this from an injury to a watch by falling on the ground. A watch-maker once told me that if the glass was broken, the works were rarely damaged; if the glass escapes unbroken, the jar of the fall will usually be found to have stopped the movement. How these jars, shakes, shocks, or concussions of the spinal cord directly influence its action I cannot say with certainty. We do not know how it is that when a magnet is struck a heavy blow with a hammer the magnetic force is jarred, shaken, or concussed out of the horseshoe. But we know that it is so, and that the iron has lost its magnetic power. So if the spine is badly jarred, shaken, or concussed by a blow or shock of any kind communicated to the body, we find that the nervous force is to a very certain extent shaken out of the man, and that he has in some way lost nerve power." We do not know how better to emphasize this point than by quoting two authors who express opinions diametrically opposed, though allowing at the same time that when force is sufficient all tissues yield. In both simple and compound fractures we have seen the spinal cord and brain injured and lesions immediately produced. Guillemand says: "Erichsen remarks in this connection that in proportion as the violence of the shock is spent in causing a fracture, a luxation, etc., just so far does the nervous system find itself spared. He makes here an original comparison: when a watch falls and its crystal is broken the works are rarely damaged by the shock; the reverse happens when the crystal escapes. This comparison, which Page criticises so severely, seems to us to be of some value. Can we not compare the nervous system of a man to the works of a watch?" Gray thus discourses upon this point: "Erichsen has stated that the brain and cord are not usually injured when the skull or the vertebræ are fractured, because the force of the blow is spent upon the bones and does not reach the underlying nervous tissues. This is a rarity, a very erroneous statement, both as a matter of physical and clinical observation; and I have been surprised that so many writers should have thought it worthy of refutation by the recital of individual cases. Every hospital interne has seen fractures of the skull associated with serious injury to the intra-cranial contents, and the frequency with which fracture of the vertebræ is conjoined with injury of the cord is well known to every surgeon of experience, and is proven by the cases collected by Thorburn; and I can myself cite many cases from my case-book in refutation of Erichsen's dictum. We should be careful, therefore, not to overlook a nervous injury when we have discovered a bony one."

GENERAL CONSIDERATION REGARDING THE CLASSIFICATION OF TRAUMATIC NEUROSES.

Gray says, "The medical world has no heredity of training in nervous diseases," that their study is of modern growth, and that fifty years ago saw its beginnings. Though this is true, the present extent and refinement of the subject make especial training necessary in its study. The fine distinctions necessary in analyzing the minutest variations in neurological cases, wherein elements complicated, delicate, and hidden constantly present themselves, demand in their elucidation adroitness, callidity, and tact. It is pre-eminently a work of delicate analysis, made necessary by the peculiar nature of the functions of the nervous system, especially the brain, whose manifestations are frequently perplexing and confusing. The nervous system and its functions constitute a field where plain and tangible conditions are frequently absent; where symptoms are present with an absence of lesions. Hence, in dealing with the intricate and abstruse problems of nervous symptomatology, the law of force and relative effect is lost sight of. In consequence, insidious and intangible influences are called into requisition by the neurologist to explain positive and severe effects. The experience of the surgeon who deals with surgery of violence as inflicted by the railway produces an opposite tendency in him. In his observations all evidence points to the fact that only competent and positive forces, as a general rule, produce adequate effects. A surgeon dealing with this class of injuries will be slow to think that the economy of man is a frail thing, to be injured by a zephyr; because almost constantly his admiration of the wonderful resistive power of the human body is excited by the fact that in his studies of these injuries he learns that even intense force does not always produce commensurate effects. Force, absolute force, is so often an etiological factor in his experience that in those cases where it is not apparent he is apt to be sceptical. Force, powerful force, may be applied to the spinal column of man, and it will still retain its integrity. He rarely sees an exception to this; at least so infrequently that there becomes impressed upon his mind the rule that a definite force is necessary for the production of traumatic consequences.

Probably the surgeon and the neurologist both confine themselves too closely to their respective fields of observation, particularly in the study of traumatic neuroses. Were the neurologist to become more of a surgeon and less of a neurologist, and the surgeon to seek to make use of the analytical finesse of the neurologist, a true interpretation of this trouble might be reached. Certain it is that there are many confusing, abnormal, and irregular manifestations in traumatic neuroses that are completely at variance with accepted ideas in pathology. Nevertheless a proper explanation will come only in the true line of normal and well-considered order.

Why should traumatic neuroses be extremely frequent after railway accidents and injuries, while in accidents under other circumstances they are extremely rare? Why should such diversity of views exist among investigators in different countries? The story of the evolution, course, and diagnostic elements of traumatic neuroses differ widely on geographical lines; and again, too, with investigators in the same realm. It will not do to say that imperfect method of investigation is the cause. No sane man will aver that either English or German authors are incompetent; and yet they present the extremes, particularly in prognosis. In any well-rounded morbid entity the differences are trivial, but in traumatic neuroses they are widely separated. Here intangible, indefinite, and inadequate influences, contrary to the normal action of things, become positive agencies. There are many cases where competent force is demonstrable and the incident trauma seems to follow in the normal order of symptomatology; but many cases occur wherein there exists an utter lack of relation between the symptoms and the evidences of trauma.

Moyer says, "That the first confusing elements in the classification of traumatic neuroses came from the attempt to use the so-called symptoms of spinal concussion," and let us add the qualifying term railway. Moyer then refers to Clevenger's definition of the complex called "Erichsen's disease as being mainly a group of subjective symptoms of a nervous and mental nature sufficiently characteristic to enable it to be recognized as a traumatic neurosis, distinct from other traumatic neuroses with which it may or may not be associated. The most common cause of Erichsen's disease is a concussion of the spinal column including its contents and appendages." According to this definition it ought to be possible for us to affirm in a given case presenting this peculiar symptom complex that a person had sustained a trauma; but this is exactly what we are not able to do. Cases are seen presenting this peculiar group of symptoms who never sustained any traumatism. When these symptoms occur without traumatism they are called spinal neurasthenia; and he has noticed in spinal neurasthenia some or all of the symptoms found in the traumatic cases; and he asks why symptoms of a purely functional character, having no other cause than traumatism, should be termed spinal neurasthenia, if the severest symptoms be called spinal concussion, or Erichsen's disease, when preceded by trauma. He divides traumatisms of the spine into three groups: 1st, those of a functional character, which should be termed spinal neurasthenia; 2d, injuries which include all of the systematic and unsystematized organic lesions to which the spinal cord is liable; 3d, injuries, such as strains of ligaments and muscles, as well as fractures of the bones composing the spinal column, and which may be followed by the varying symptoms of spondylitis. He thinks that with this grouping diagnostic differentiations, while not easy in every case, will be possible; and that within one year of receipt of injury we can formulate a prognosis approximately correct, which is impossible under former symptom groupings. Injuries to the head are grouped the same as those of the spine.

Here is an attempt at classification in accordance with just ideas; an endeavor to classify according to a somewhat tangible and consistent grouping of symptoms, devoid of supposititious elements. Again, Bramwell, who, in our opinion, uses rare common sense in the analysis of this condition, plainly indicates that as a rule competent forces only act, be these in the direction of either physical or psychic trauma. He has demonstrated upon colliers that competent forces produce immediate and competent effects.

The writer, after a goodly number of years of experience, finds that so many abnormal and erratic conditions have been described by observers which cannot be explained upon a common-sense basis of thought, that the whole subject appears confusing. Thus, out of 18,885 injuries to employees, occurring during a period of over sixteen years, a large number of which were seen personally, only 8 cases of pure traumatic neuroses occurred. Of these 8 cases only 2 still present symptoms of the trouble. To more forcibly illustrate the infrequency of the malady, of 18,885 cases of injury, including 1,014 injuries to the back, there occurred but one case of traumatic neurosis among 2,360⅝ employees injured. Among 844 passengers injured, there were 127 injuries to the back; and of the total number there were 13 supposed cases of traumatic neurosis, or one passenger in 65 had this trouble. We will admit, for the sake of argument, that, owing to the surrounding circumstances and the familiarity with conditions, employees are less likely to have traumatic neurosis; still the difference is so enormous that other causes have to be sought for, hereditary or predisposing causes constituting an important factor. The surgeon who deals with the injuries incidental to the violent accidents on a railway, not being impressed with the influence of insinuative force, frequently interprets the conditions seen according to the force manifested. And we candidly believe that where back injuries have occurred, and, true to the general principles underlying his art, the surgeon fulfils the rational indication for rest, the best course is pursued. We cannot but think that were the neurologist to follow out the idea of rest in the cure of an inflamed condition there would be fewer cases of traumatic neurosis.

The surgeon, when he finds that incidental to the infliction of an injury there is pain in the back which motion intensifies, true to the principles of surgery, would apply rest to these parts, putting upon the injured individual the plaster casts as suggested by Sayre. And I believe that in imposing rest upon ruptured ligaments, muscular attachment, and injury to the bone, many elements of irritation would be withdrawn, and the individual would stand a better chance for cure than when the methods of the neurologist are used. Of course, we do not wish it to be understood that we apply the plaster jacket to all cases of lumbar sprain; but when the acute stage has passed, and persistent pain is complained of, then we invariably apply it. In the method of the neurologist functional conditions are studied minutely and analytically to the exclusion of physical conditions; and the mind of the patient is fed with suggestions to the intensification of the neurotic state, while the principle of rest is ignored. We do not say that where purely functional troubles exist this mechanical method of treatment would always accomplish a cure; for we can readily see that under certain circumstances psychic shock might be absolutely profound. In any attempt at a classification, every detail entering incidentally into the infliction of the original injury should be considered. It is not common sense to believe that where all the circumstances are of an ordinary kind and free from harrowing elements, and where jolt and jar are but feebly represented, marked psychical shock could be produced; but where all attendant circumstances are intensified to the extreme of horrifying calamity, the pyschic reaction might be plainly manifest, comparable to those described as common in traumatic neuroses.

Our experience includes the study of some 113 cases of injury to passengers, where the mental effects produced were comparatively mild. The effects observed can be best illustrated by describing the conditions found after a derailment where some 18 people received divers bruises, incised, contused, and even lacerated wounds. A train, every car of which was loaded with passengers, was derailed in the middle of the night, when probably all the passengers were at rest, or at least in a position of rest, and many probably in profound slumber. Within two hours after the accident, the patients were examined, and none of the evidences of unusual fright were manifested. While ever anxious to discover these peculiar psychic symptoms after derailments, collisions, etc., it has always, in our experience, been possible to demonstrate that such effects were in proportion to the violence inflicted, the attendant circumstances of horror, the direct force, the jolt, the jar, the twist, or the strain. Our experience shows that mild conditions invariably beget mild effects, except where predisposing causes produce their effects from apparently trivial injuries. We can but agree with Byrom Bramwell in his recent utterances upon concussion of the spine with especial reference to railway injuries. He asserts that in injuries arising outside of railway accidents their effects are plainly normal in their manifestation; but within the realm of railway injuries all normal reactions are frequently absent, and many cases are constantly seen which reason cannot reconcile. Bramwell plainly shows that in colliers direct injuries usually produce direct results; that these results are, as a rule, of a definite and normal term, and in general do not seem to leave permanent nervous lesions behind. When lesions do occur they are merely in the nature of coincidence. And our own experience has plainly indicated to us that direct blows, direct force, almost invariably produce direct results. We can readily see, as indicated by Bramwell, that conditions alter results. In old or weakly and debilitated subjects the effects certainly would be more permanent; but even in the most unpromising cases a very considerable degree of improvement takes place. Organic lesions of a secondary kind are so infrequent that in an experience extending over a period of nearly sixteen years, it never has been our privilege to see a case of meningitis, either acute or chronic, or myelitis, except after compound injuries where fractures of the spinal column had been inflicted, and the membranes and spinal cord contused and lacerated.

As for the influence of predisposition, we believe that we are as keen in recognizing it as is the neurologist; because we view it as a factor wherein probably more than one-half of the case has been made prior to the infliction of injury.

A CONSIDERATION OF HEAD INJURIES CONDUCIVE PARTICULARLY TO TRAUMATIC EPILEPSY AND TRAUMATIC INSANITY.

Prior to entering on the consideration of the influence of trauma in producing functional and other troubles of the brain—epilepsy and traumatic insanity—it will not be out of place to endeavor to analyze injuries occurring to the head. Whether much more than a relative idea can be obtained, we will not attempt to say; but certain it is that traumatic insanity and epilepsy are very rare in the observation of the surgeon who attends to the immediate injuries of the head.

Of 21,939 injuries—as before stated, tabulated by the writer during the past sixteen years—18,885 were to employees; 844 to passengers; 2,503 to non-employees. Of the 18,885 employees 54 sustained fractures of the skull, 1,016 sustained scalp wounds of various degrees, 29 sustained concussion of the brain, and 88 were more or less contused about the head; making in all 1,187 head injuries. There were inflicted upon the 844 passengers 5 fractures of the skull; 144 received scalp wounds; 4 sustained concussion of the brain; and the contusions of the head numbered 14. Injuries to the head were inflicted on the 2,210 non-employees or trespassers as follows: 23 fractures of the skull, 150 scalp wounds, 11 concussions of the brain, and 22 contusions. The total, including passenger, employee, and non-employee, is 1,660 marked injuries to head alone. When injuries of the face are included the total becomes 2,455. It is impossible to determine the absolute degree of force exerted where shock is transmitted through the legs to the vertebral column and brain, as would happen not infrequently where persons jump or fall from moving trains, but the traumatic neuroses are often attributed to such shock. In these ways 1,866 injuries were inflicted, in which transmitted shocks must have influenced the spinal cord and brain more or less. Thus we have 4,321 injuries in which the brain was more or less menaced.

It can be truthfully stated that so far as the employees were concerned they were under constant treatment, and in each case a comparatively truthful history was obtained of the origin and result of the injury. The infrequency of occurrence of functional brain troubles was constantly marked. The extremes of intensity and degree were constantly met; and if force were a competent factor which acted with any degree of regularity, certain it is that epilepsy and traumatic insanity would be of constant and unceasing occurrence. There were fractures of the skull with extrusion of the cerebral substance, and still no marked brain trouble followed with any degree of regularity. Where most might be expected the least was found.

Such experiences as this on the part of the surgeon who treats the surgery of violence or accident, beget in him a profound admiration for the wonderful resistive capacity of the human frame. Immediate death is a more frequent accompaniment than ulterior consequences. Knowing that for the production of epilepsy, traumatic insanity, and abscess of the brain, after head injuries, months and even years are necessary, the surgeon may acknowledge the impossibility of the causal relation, but its existence can rarely be clearly demonstrated.

In the great number of cases mentioned there were but three cases of head injuries where epilepsy was the product of injury. In two of these the epilepsy was plainly due quite as much to other conditions as to the injury to the head; in the other case, however, the injury and the epilepsy seemed to be directly related as cause and effect. There were three cases of traumatic insanity produced directly from the beginning of the injury. These cases will be mentioned under the heading of traumatic insanity. Of two of these we have more or less complete notes; the third case was removed before we could get a consecutive history.

TRAUMATIC EPILEPSY.

While realizing to the full extent the power of trauma to produce diseased conditions, it is a remarkable fact, that lesions of important organs very rarely occur after railway injuries, and this is notably true of injuries to the head, notwithstanding the reputed frequency of functional trouble of the brain and spinal cord arising from trauma. Tumors of the nature of embryonic tissue may appear connected with the seat of a contusion, or in a wound at the seat of repair, but their occurrence, while possible, is rarely probable. And it certainly could not be viewed in the light of a menace to the future usefulness of the individual that a tumor could occur as result of injury. There is no element of uniformity or regularity in the occurrence of new growths after injuries, and probably predisposition is a causative factor in their development under such circumstances. Injuries to the brain or spinal cord may likewise lead to the development in them of a tumor, but, as before stated, such an occurrence is purely in the nature of coincidence and dependent upon predisposition. Admitting that tumors of the brain and spinal cord arise after trauma; that insanity, encephalitis, chorea, epilepsy, and locomotor ataxia do now and then occur in consequence of head injuries—after all it is only in the realm of intense speculation to attempt to define any degree of regularity in connection with their occurrence. No common-sense practitioner would for a moment aver that they were at all likely to occur, remembering how many diseases constantly arise in the human nervous system for which we are utterly unable to give any proximate etiology. We have not as yet formulated anything like a positive rule which enables us to state that such and such an injury will produce such and such results. It is a noted fact that where influences of the most severe type have been operative, frequently we have no untoward results produced; and, on the other hand, that the most trivial injuries sometimes beget results which we are utterly incompetent to explain. Any degree of uniformity is never manifest: erratic, unforeseen, and uncertain results do occur, but they are so diverse that they can only be viewed as unusual. Thus, when epilepsy, insanity, and locomotor ataxia develop after injury, the sequence is so unusual that it must be regarded as coincidence. This holds true where these diseases result, as they do occasionally, from injuries inflicted upon the railway. Each and every case must be considered upon its own merits. When progressive muscular atrophy, myelitis, locomotor ataxia, insanity, or epilepsy follows trauma, it is an unusual result, and heredity, predisposition, or other etiological factors must be brought into requisition to explain the condition. No attempt will be made to enumerate the diseases produced by trauma, particularly those of the brain and spinal cord, as that would necessarily entail too extended an account of maladies which are not considered in this paper. We will take up only those injuries which are most constantly produced—traumatic epilepsy, traumatic locomotor ataxia, and traumatic insanity. Injuries of the head are occasionally followed by epilepsy, but such a consequence is so infrequent that it is always considered an unusual occurrence.

According to present ideas, concussion of the brain is a condition where symptoms are due to lesions rather than to functional troubles. There is more frequently a laceration of the brain than mere shaking of the cerebral mass. Viewed in this light, certain it is that the varying degrees of concussion seem competent to produce epilepsy. The severity of the accident is not necessarily expressed in commensurate effect; for it is a well-known fact that not infrequently where an injury occurs to the membranes of the brain the effects are more manifest than where the brain itself is injured. It is not an unusual occurrence to have the cicatrix on the scalp unusually sensitive, and an aura may start from this painful cicatrix. Hirt says: "Among the exciting causes there is in reality only one, the mode of action of which we are able to understand to any extent; and that is traumatism, and, more especially, injuries to the head. It may happen that a person previously perfectly well is taken with an epileptic fit after a fall or blow upon the head, but here we must distinguish between injuries which cause a lesion of the brain cortex and those which do not. In the former case the lesions become the direct cause of the attack, and we have not a genuine epilepsy, which we said was one based upon no appreciable anatomical changes, and which therefore only occurs if the brain be uninjured. We must carefully examine the scalp and overlook no scar, however trivial; because any one may be the cause of the epilepsy. The probability becomes a certainty if the cicatrix is adherent to the bone beneath it, and is painful to the touch, and if it is possible by firm pressure to bring about an attack. In this case, as we shall insist upon later, excision is indicated. The attack which occurs in consequence of this pain is a reflex act, and this kind of epilepsy we call reflex epilepsy. Such reflex attacks may also be caused by painful cicatrices on the peripheral nerves at any point of the body, or where there exist ulcerative processes, for instance of the finger-nails. In one of my patients it was possible every time to produce an attack by pressure upon the diseased matrix of the nail, the same thing occurring also when he accidentally struck it against anything. The amputation of the terminal phalanx was followed by a complete recovery, after all other measures had proved fruitless." We know that not only fragments of bone but scars of the dura mater and the brain itself are causes of epilepsy. In the consideration of traumatic epilepsy it will do to bear in mind that remote cicatrices are likely to produce this trouble. We find mentioned, in the "American Text-Book of Surgery," a case related by Dr. Briggs, in which a girl had not only depressed fracture of the skull but a necrosis of the tibia. He first operated on the tibia and after five years the fits had not recurred, plainly pointing to the fact that the depressed fracture of the skull had no influence; but that the irritation sprang from the diseased condition of the tibia. It has been remarked by Gray and White that any trivial operation or any trivial change in treatment will very probably cause a cessation of the fits for weeks and months. Hence common sense and experience indicate that at least three years must elapse without the return of the attacks of epilepsy before we can announce a certain cure.

Prognosis in these cases is generally grave, particularly where the epilepsy has persisted any great length of time. Though recoveries are now and then obtained and relief frequently follows operative procedure, the most experienced surgeons always give a reserved opinion. Moullin claims that in many cases improvement has not only been marked, but has persisted. Again it is asserted that psychical influences may become the direct cause of epilepsy—epileptic seizures. In some cases fright has been given as the cause, but in such cases there must be other causal conditions at work which in our ignorance we are unable to define; and no competent practitioner would state under oath that he was absolutely sure that psychic shock was the cause and the only cause of epilepsy in a given case.

It is also known that alcohol, certain articles of diet, and some drugs, notably cocaine and antipyrin, may produce this condition. Such causes might be at work in cases where there had been preceding trauma, and it would then be impossible to decisively determine the etiology.

TRAUMATIC INSANITY ON RAILWAYS.

While the assertion that the surgeon does not very generally encounter traumatic insanity arising immediately from injuries to the head is correct, yet now and then, in isolated instances, cases occur. The rarity of the occurrence of insanity immediately after injuries, and the length of time which it may take to develop it subsequently, naturally bring it first under the observation of the neurologist. If the modern views of concussion of the brain are correct, that laceration of cerebral substance is produced, that there is a lesion rather than a functional disturbance, it certainly would seem natural that insanities should arise incidental to infliction of injury on or about the head. But even where insanity is thus produced there remains an element of uncertainty regarding the direct causal factors, simply owing to the fact that no finely drawn line divides exciting from predisposing causes of insanity. And in such a case no well-informed, honest practitioner would assert with absolute surety that the insanity was the immediate result of the injury inflicted. And this is especially true in those cases where insanity develops years after the injury, and predisposition, heredity, and other causes have been operative in the interval. Positive causal relation can be predicated only in those cases where the anomalous mental condition has been plainly present from the time of the infliction of the injury. Traumatism, there can be no doubt, is oftentimes both a predisposing and an exciting cause of insanity, but all authors agree that when such cases are thoroughly studied an inherited taint is found to be a very constant and unceasing factor in their production. At the same time, in judging all such cases, it is very important to take into consideration the full force of the constitutional effects produced by the trauma, and the result of possible debilitating diseases, causing impaired nutrition. The influence of overwork also, and brain strain, which would naturally aid and assist in developing a diseased mental condition, must not be overlooked. While there may be marked clinical elements distinctive of insanity arising from traumatism, yet it has not been proven that any especial form is pathognomonic. Cases arising after traumatism may be complicated with some existing constitutional taint, such as syphilis or alcoholism. If such a taint exists at the time of the infliction of the injury, it may certainly be a more potent cause than the injury itself. We do not propose to attempt to classify the various forms of insanity appearing as results of trauma, as this study more properly belongs to the neurologist. Clevenger says the average proportion of traumatically caused to other forms of insanity is 5.4 per cent., ranging, with different asylums, from one to ten per cent. of the admissions; and that they are probably related to other insanities in from one to two per cent. of the cases. About one-fifth of all the cases are from head injury. The percentage of head injuries terminating in insanity has never been accurately determined. We find that out of 18,885 injuries to employees we had 1,187 injuries to the head. In this entire number but three cases of insanity occurred, and two of these cases were developed almost from the beginning of their injury. Our records possess no value except as refers to the immediate production of insanity.

It will not be out of place to give notes concerning these two cases.

An employee was thrown from an engine, striking on the back of his head, fracturing the occipital bone on the left side about one inch and a half from the occipital protuberance, involving the lateral sinus of that side. The fractured bone was removed, and the sinus plugged with absorbent gauze to stop an excessive hemorrhage. Mania occurred from the beginning, of varying intensity. There were recurrent and furious outbreaks at times, days apart, with great insomnia. There was exaltation of memory. The patient would repeat words of songs with accuracy, and sing correctly all day long, one ballad following another almost without intermission. The outbursts were explosive, with formulated speech. He used unmeaning expressions continuously, with a repetition that was remarkable. He invariably commenced his talk or his song with these expressions: "Page Muggling, Judas Priest." His outbursts gradually increased in furiousness, and he died en months after the receipt of his injury.

In the other case there was a fracture of the skull upon the occiput near the junction of the lambdoidal with the sagittal suture. The skull was comminuted at this point. There was no pronounced injury to the dura mater. The insanity was of a stuporous form. Owing to the fact that the patient was removed from the hospital it was impossible to follow this case, but it was learned afterward that he died demented in the fourth month from the receipt of his injury.

What concerns us most is the medico-legal aspect of cases of so-called traumatic insanity.

Inasmuch as the law will not consider speculation, but insists upon the production of evidence of usual, natural, and proximate facts, it is rare indeed for these cases to come up for consideration in courts of law. It is granted that many troubles and diseased conditions seem to be dependent upon trauma, particularly as regards the brain, but unless immediate and proximate effects are well pronounced and plainly shown, the influence of trauma is not considered.

The occurrence of traumatic insanity after railway injuries has been so infrequent as almost to debar its consideration under this head.

Before concluding this portion of our chapter we desire to mention a case wherein it was claimed that traumatic insanity was produced by the persons being struck lightly upon the head by the gate-beam which is used on the railway crossings to close the street when trains are passing. The blow in this instance was not sufficient even to occasion a solution of continuity of the scalp, but only a bruise. The individual after his injury had his head examined, but no condition was found which indicated that anything like a forcible blow had been received. The patient for years had been an alcoholic. His mind became gradually affected with the usual symptoms manifested in alcoholic insanity. It was asserted by his friends that the injury had occasioned the changed mental condition. Yet this same man was put upon a jury which tried a prisoner for murder, and it was averred that his actions upon this occasion were as sensible as those of his fellow-jurymen. He continued the transaction of his business, and evinced shrewdness and money-making capacity. A claim was filed for damages to the extent of twenty thousand dollars, which was compromised by the railroad company for about one-twentieth of this sum. His mental condition is now essentially the same as it was years before he sued the company.

LOCOMOTOR ATAXIA.

Locomotor ataxia is more frequently due to syphilis than to all other influences which may act as causative factors in its production. Different writers state that antecedent syphilis is found in from thirty to ninety per cent. of the cases. The influence of trauma in the production of this trouble, it is claimed, has been certainly demonstrated; but in a goodly number of instances it is impossible to draw the dividing line between the positive influence of trauma and the influence of syphilis. There can be no doubt that in the presence of syphilis trauma may become a powerful factor. Hirt mentions the case of a patient of his who contracted syphilis, twenty-nine years before he met with the accident; and a few months after the accident tabetic symptoms developed. Gray asserts that it is a certainty that locomotor ataxia can be caused by injury, especially by one of a general nature; and he says: "One of the most marked cases of this disease that I have ever seen quickly followed the celebrated Ashtabula railway accident, where a train was precipitated from a bridge at a height of three hundred feet."[1] It has been asserted by authority that a fall from a height may be the cause of this trouble. The most recent author states that years may elapse before the disease makes its appearance, and that traumatisms may have an influence in determining the seat of the early symptoms. Of the influence of other conditions, as where overexertion and hard bodily labor are said to cause it, it is not necessary for us to speak here, as they do not properly come under the head of this subject.

The positive influence of trauma as a cause of this disease is still largely in the realm of speculation, as expressed by Byrom Bramwell. Thus he says, in substance:[1] Such common diseases as transverse myelitis, locomotor ataxia, and progressive muscular atrophy could only in a very small proportion of cases be attributed to traumatic injury. It was a remarkable fact that these undoubted cord lesions were met with very rarely indeed in persons who had previously suffered from railway accidents or injuries. Some of these diseases were so common that, on the mere theory of chances, they ought every now and again to occur in persons who had been injured in railway collisions, but he had never met with any case of the kind himself. The wonder was not that they did occur, but that they occurred very rarely. The possibility of the mere coincidence of occurrence must be remembered. The fact that such a disease as locomotor ataxia did develop after injury to the back did not necessarily show that it was due to the injury to the back. Each case had to be individually considered before any such conclusion could be arrived at. While he was willing to admit that all these diseases did occasionally result from traumatic injury, and every one of them might in rare and quite exceptional instances result from injuries received in railway accident, he emphatically maintained that such a mode of origin was most uncommon and quite exceptional. It constituted no argument whatever for the belief—on the contrary, he maintained that it was a very strong argument in opposition to the belief—that the nervous symptoms which so commonly resulted from railway accidents and injuries were due to organic diseases of the cord or its membranes.

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[1] Gray certainly must be mistaken as to the height of this bridge, as Adams in his work on "Railway Accidents" says this bridge was only sixty-nine feet above the bottom of the ravine.

In our own experience, after having personally treated a great number of railway injuries, we have never yet been able to show that trauma was a cause of locomotor ataxia. And, strange as it may seem, among some twenty-eight cases treated in railway hospital service, none ever averred that he had been injured, or seemed to regard injury as a cause of his trouble.

We are free to confess that it is only of late years that we have considered the production of tabetic symptoms in connection with trauma. Possibly closer and more analytical examination might have developed the contrary.

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[1] London Lancet, *loc. cit.*

CHAPTER IV.

AN ANALYSIS OF THE MEDICO-LEGAL DIAGNOSTIC ELEMENTS ENTERING INTO TRAUMATIC NEUROSES AND OTHER CONDITIONS ARISING FROM RAILWAY ACCIDENTS.

1st. A consideration of litigation and some inconsistencies.—2d. The reason why the expert is employed.—3d. Frequency of simulation.—4th. Defects of vision as diagnostic signs.—5th. The importance of complete history of cases.—6th. General elements of the examination.—7th. The dangers of long-continued and multiple examinations.—8th. A study of objective symptoms—Face.—9th. Gait and attitude.—10th. Locomotion and test for co-ordination.—11th. Disturbances of special senses—Diagnosis.—12th. Disturbances of the circulatory system.—13th. Fibrillary tremblings of muscles of face and influence on speech.—14th. Digestive disturbances.—15th. Tests for sensibility—Their vagaries.—16th. The Mannskopf sign.—17th. Influence of compensation upon the clinical features of railway injuries.—18th. Malingering—A general consideration.—19th. Special characteristics of malingering and exaggeration.—20th. So-called detective means to determine malingering.—21st. A consideration of precedent diseases, or so-called substitution of origin.

A Consideration of Litigation and Some Inconsistencies.

It is an almost invariable rule that where personal injuries have been inflicted by the railway, claims for damages are made. However, it is not an infrequent occurrence to have the good sense of both corporation and injured individual manifested in just compromise. This should always be commended, as aggravating circumstance is almost completely eliminated, and what might ultimately be harrowing and pathologizing conditions to the person injured rendered null and void. Elements attendant upon litigation, particularly where we have marked psychic trouble, as presented in traumatic neurosis, possess positive causative influence, and seem almost invariably to pertain to the abnormal. Thus, continued mental tension, the violent play of passions—at times exaltation, then deferred hopes, stinging delay; vexatious suggestion, harassing expense—engender a wretched and unfortunate psychic condition. The unimpeded and full force of immediate surroundings, wherein every element is seemingly made to act in its most effective manner, favor a condition of unrest and debilitating circumstance, continued from beginning to end. The excitement, strain, and harassing elements, which are generally attendant upon litigation, even in ordinary matters, seem to be competent at times to create neurotics out of men in normal condition. What, then, must it do to an already diseased individual? All experience indicates that cases of traumatic neurosis invariably grow worse while any legal suits are pending; that impassioned circumstances and termless tension stamp themselves profoundly upon the already weak mental condition. Hence the conscientious medical attendant uses, as an element of treatment, anything to quiet the psychic condition. He will explain the full meaning of compromise, indicating honestly to the patient that the unrest incident to litigation robs his remedial measures of efficiency. He will suggest that an early settlement is one of the means of cure; that is, if cure is possible, all elements of excitation are to be eliminated in the treatment of his case.

In an experience of many years we find that many railway corporations recognize the honest opinion of scientific men, and use compromise as an economic and intelligent factor in dealing particularly with cases of traumatic neurosis; being equally as anxious as the patient to avoid a long, tedious, and expensive suit.

Many cases of traumatic neurosis are emphasized, nourished, and developed by surroundings and circumstances which are oftentimes more potent in their effects than the initial injury. Thus, E. C. Seguin[1] says: "Supposing the case of a predisposed person, frightened and jarred by severe accident, who subsequently receives harmful sympathy from relatives and physicians, who is made the object of multitudinous suggestions by physicians, lawyers, and friends; whose volition and reactive powers are impaired by nervines and sedatives; then, even without a trace of voluntary or intentional malingering, a neu-

[1] Annual of the Universal Med. Sciences, 1889. F. A. Davis, Pub., N. Y.

rotic state is developed which gets beyond—utterly beyond—the control of the patient and the influence of the treatment. Such a patient has lost hold of his nervous system, after the fashion of the morphinist, and cannot regain control." In many cases of so-called traumatic neurosis, the only advocation at times is an injury upon a railway train as passenger. It is immaterial what the attendant conditions were; whether gravity and force played their part even in their feeblest forms. A passenger, slight collision or derailment, and then the assertion "that it will not do to conclude that the blow should be severe to produce a permanent injury," are sufficient. In unison with this thought, any one who will examine court records of the past will discover continuous injustice in the findings for or against railway corporations. A spirit of unfairness has been evolved, where justice is lost sight of, and medical experts, both for plaintiff and defendant, losing the true and real intent of experts, have become factious partisans, thereby producing on court, attorneys, jury, and laity a conviction of the thorough unreliability of medical expert testimony, suggesting at times even its dishonesty. So deeply ingrown has the prejudice against railway corporations become, that we have heard an intelligent and zealous attorney say that if he could but indicate that his client had the sensation of "pins and needles," suggesting the bare possibility of paralysis, he could descant darkly on the future, and nullify scientific testimony. No more complete farces have ever been enacted upon the stage than in the forum of justice. Such failures are largely due to ignorance in the selection of experts, who are generally chosen by the attorneys themselves; and, again, cupidity eternally faces honest assertions, and possible ulterior results are made a pretext to accomplish absolute dishonesty. The anomalous positions in which experts are placed discredit them. With unprincipled motives, experts are called into court, after no more than a single examination of the alleged sufferer has been made. The medical expert for the railway, or defendant, is not infrequently refused the courtesy of an examination. Decided opinions are given with unconcern by the plaintiff's expert, after no more than a single examination. In consequence, ignorance and injustice cloak themselves in the garb of science.

No honest physician desires either to harm or to do injustice to a railway corporation, and certainly no one could wish to injure an honest and gravely injured individual. Still less would a physician seek to be a party to fraud by assisting a dishonest claimant in obtaining damages.

Physicians well versed in the literature of traumatic neuroses cannot possibly believe that a single examination of a case will enable them to determine and verify symptoms. It is an established fact that the differential diagnosis of traumatic neurosis has not its parallel in all medicine, and that oftentimes at least a year or more may be required for observation before a just prognosis can be given. Where the usefulness and mental and physical integrity of an individual are involved in an opinion, honesty and justice demand that it be based upon efficient and conscientious study. We believe that scientific investigation will soon demonstrate that regularity and consistency are not to be subverted even by traumatic neuroses. The law demands, in questions of doubt, that only usual, natural, and proximate effects shall be considered; that which is remotely speculative must be ignored. The law likewise requires that in all cases of personal injuries, the recovery of damages shall be exactly commensurate with the injury sustained.

What expert can truthfully state even approximately the full measure of damages when imperfect methods of examining injured individuals are pursued? There could be no honorable demand for damages for complications foreign to an original injury; for complications engendered by diverse conditions, having no direct relations to the injury for which recompense is sought. In all other conditions following injury, the true relations are considered, but in traumatic neuroses, aiding and developing factors are placed to the credit of the primary cause. In these cases no account is taken of the influence of suggestions or omissions on the part of the physicians or attendants, even though they may have created neurotic conditions, and the railway company is made to bear the full weight of causation. But with reference to such factors, unless a sharply defined line is made apparent, we then enter the realm of speculation, where the law will not follow us. Moreover, an injured person is required to use only a reasonable degree of care to prevent or avert serious consequences; and therefore, if such a one has exercised reasonable caution and prudence in the selection of a physician's attendance and surroundings, he has fully met the requirements of the law. But there is no proper definition of what reasonable caution and prudence are in the selection of a physician. The law, in its endeavor to be broad and liberal, becomes inefficient and unjust. How incongruous and inefficient are its workings in this direction!

Certain it is that only the competent neurologist, or at least one versed in observation of this peculiar condition, is competent to correctly diagnosticate and treat it—a disease susceptible to the influence of every adverse condition, fed by suggestions, and nourished and intensified by unfavorable circumstances. The statutes of various States demand only a legalized physician; and in such States the sole requirement to legalize a physician is so-called practice of medicine. Medical knowledge and education are not the criteria, but length of time spent as a practising physician. Though a man may be a "quack" of the worst order, he may still be a legalized practitioner of medicine. Again, in more than one State of our country we find boards of medical examiners, whose duty it is to pass upon the qualifications of would-be physicians; but frequently these boards are composed of the most inferior and incompetent members of the medical profession; men whose education often has not gone beyond reading and writing, with no thoroughness even there. If men devoid of education are thus made legal practitioners of medicine, the fault lies with the public.

THE REASON WHY THE EXPERT IS EMPLOYED.

Compensation is certainly invariably an important factor in these cases. Upon an expert who gives testimony in them is imposed the necessity of being competent in this line of work. For, in ascertaining and estimating the amount of compensation to be awarded in actions for personal injuries, it is necessary to consider mental anguish, physical pain, and the extent and permanency of loss of earning-power. It is important that the physician and the attorney should have a degree of knowledge and information concerning the relationship which mental and nervous forces bear to the physical facts in any given case that will enable them to present tangible evidence, definite proof, of the extent and consequences of injuries. Since the damages awarded for physical and mental pain, etc., are compensatory and not punitive, it becomes very important to be able to prove, with some degree of exactness, the amount of physical suffering and permanency of the effects produced by a given injury. Mental pain is inferable from demonstrable physical pain. Again, mental pain may be engendered incidentally by the intensity of surrounding force and circumstances. Aside from these relations, a true interpretation of purely subjective phenomena can only be made by the experienced expert. The layman has no guide in the determination of the degree of pain, be it mental or physical, unless he has experienced personally similar injury and pain. But the physician, aided by his own and the experience of others, can approximately estimate from physical facts the degree of intensity of pain consequent upon injury, as well as its extent and permanency. Such features always require the employment of expert testimony. Without it, a jury would be left to draw conclusions from the imperfect data of limited experience and observation.

There rests upon the honest and conscientious physician a real and great responsibility in the examination of these cases; and any physician who begins prejudiced surely starts wrong. His examination should be made in the light of existing science, and the more closely he adheres to the true intent and purpose of science, the more surely will he accomplish the real and intended purpose of the examination. Warped and prejudiced opinions in the beginning of an examination naturally entail warped and prejudiced conclusions. There should always be that just appreciation of that high moral obligation which the true nature of his vocation imposes upon him; there cannot possibly be any value attached to views influenced by prejudice. The first endeavor should be to determine what connection there is in the person under examination between the present illness and the accident of which he is supposed to be suffering the consequence. Of what degree is the incapacity? Is he only partially or completely disabled? How long is this disability likely to continue? Is there exaggeration, and what is its extent? What is the degree and extent of simulation? Or is it a case of gross malingering?

At the outset of an examination it is to be remembered that the symptoms may partake of the characters of both traumatic hysteria and neurasthenia; that such symptoms are more or less commonly associated with back injuries, sprains, contusions, concussions where we have muscular and ligamentous sprains or ruptures and injury to spinal nerve, and, as expressed by Dana, "mental shocks and physical bruises."

THE FREQUENCY OF SIMULATION.

It is certainly confusing to note the relative differences in the views expressed by various authors concerning the frequency of simulation; and that, too, under the varying changes which a single year brings forth. In this country it is rare indeed to have patients placed under proper conditions for thorough scientific watching. For many years past we have heard experts deliver decided opinions after only a single examination of a patient; as for repeated examinations, they are very rarely made except by the thoroughly conscientious and competent neurologist or one particularly versed in this trouble. We believe that it can be honestly maintained that no one can even approximately determine the extent and absolute condition of such patients by means of one examination; that under some circumstances, months are required to honestly pronounce upon a case of traumatic neurosis, especially regarding prognosis. How is it possible, where such loose methods are employed, to avoid strengthening the impression, already made upon the legal profession and the courts of law, of the thorough unreliability of expert testimony? Where the interpretation of truth is based upon such imperfection, certain it is that if the surroundings as exemplified by lawyer and court were not as eagerly indifferent and prejudiced, such falseness would not be tolerated. As Colton says: "The interests of society often render it expedient not to utter the whole truth, the interest of science never; for in this field we have much more to fear from deficiency of truth than from its abundance." E. C. Seguin[1] says: "It has seemed to me that the question is not fully considered by writers upon the subject regarding the elements of malingering; they all refer more or less to deliberate malingering, which we admit is rare. But in private practice, in cases of non-traumatic neurosis, we are constantly confronted with elements of exaggeration and positively false statements made by patients who have no immediate or pecuniary object in view. Under the most unexpected circumstances, we discover, usually long after the first examination of the case, that certain symptoms are either purposely produced or grossly exaggerated. In railway cases, where we have examined this element of possible non-deliberate malingering, it has been very prominent. For example, in a case recently seen, the patient could lift and turn her heavy body by the help of her hands, yet her grasp on the dynamometer gave the ridiculous figures of 5.3 degrees, or, in other words, no grasp at all."

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[1] *Loc. cit.*

Again, Spitzka says: "The most difficult element in these cases is the distinction of the genuine disorder from simulation. As far as I can judge from the testimony given in a number of them as to the existence of real or feigned disease, I should be inclined to believe that over one-half of those in which the verdict has been secured, including several in which very large sums have been paid, were and are shams."

In a recent discussion before the British Medical Association[1] elicited by the reading of a paper by Dr. Byrom Bramwell on "Concussion of the Spine, with Especial Reference to Railway Accidents and Injuries," the following were the reported utterances regarding the frequency of simulation:

Dr. Buzzard of England averred that there was so much simulation in railway cases that he had positively declined seeing them. Dr. Clifford Allbutt of the same country asserted that ninety-nine in one hundred cases of so-called traumatic neuroses arising from railway accidents were simulated and nonsensical. Dr. Brookhouse asserted that simulation of symptoms of concussion were constant and simple. In fact, the concurrent opinion of English surgeons seems to be constantly at variance with those of continental authors. The extremes are to be found in a comparison of English, French, and German writers. Bouveret and Dubois of France believe that simulation is extremely rare. Owing to the wonderful influence of Oppenheim, German physicians present much contrariety of opinion regarding simulation. Oppenheim finds only four cases of simulation in one hundred. Hoffman observed in twenty-four cases eight simulants; he and Schultze claim that thirty-three per cent. of all other cases were simulated. Schultze now, on reconsideration, claims that his former high per cent.

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[1] New York Medical Record, August, 1893.

was excessive, and places the simulations at ten per cent. Rumpf of Marbourg places the percentage at ten per cent.; Seeligmüller of Halle still places his estimate of simulation at twenty-five per cent. In our own country, our best authors have not been at any time very expressive as regards the percentage of simulation, but many writers have been very free in expressing their opinion regarding prognosis. Putnam, Knapp, and Dercum claim that simulation is of rare occurrence. Walton is inclined to the belief that simulation is somewhat frequent. It is hardly necessary to quote at length the various beliefs in this direction; suffice it to say that extremes are constant, some physicians of experience averring that simulation runs as high as seventy-five per cent. It has been asserted by strong authority that there are objective evidences present in every case, which, while they may evince more or less elements of uniformity, have not yet been properly formulated; and the true method of absolute determination of simulation has yet to be proposed. It is said that by varying the examination one may exclude simulation and constantly verify results.

We have purposely given these wide differences in percentage because there must undoubtedly be some very strong reason why they should exist; and it suggests upon the face of these varied assertions that racial differences probably have influence. No one can dispute the honesty of the author quoted, nor can his fine ability be questioned. It can be asserted with truth that investigators in France, Germany, England, and this country describe these cases just as they are seen.[1] Hence, if the assertions attributed to the various writers are true, there must be a radical difference between cases reported in England and those reported in France and Germany. It is not an illogical reason to assign, that probably there is something in that unknown factor of racial element which is competent to produce varying effects; this may be particularly emphasized in traumatic hysteria, to what extent has never yet been determined. While this might partially explain, still it has been asserted that mechanical contrivances used upon the railway at the

[1] Thus, Clevenger says: "S. Weir Mitchell during the late war made extensive researches with regard to direct injuries to nerves, and the traumatic neuroses described in his book differ widely from those investigated by Oppenheim." So acute an observer as Mitchell certainly described just what he saw.

present time—the Westinghouse brake, the vestibule—have, in many instances, changed the conditions which accompany these accidents, and that traumatic neurosis as described at the present day does not present some of the essential conditions which were engendered when Erichsen first described this condition. While this may be so in a goodly number of instances, while the very elements of force have been materially lessened by these appliances, yet it cannot be a constantly acting, modifying cause, particularly in those cases where circumstances engender fright-neuroses, with or without any evidence of physical injury—where we have the so-called "egg-shell" organization, as expressed by Clevenger, which merely indicates a constant predisposing cause, be it in the shape of a predisposing neurosis or where there are other evidences of constitutional deficiency. We do not desire to detract from the full force of predisposition, which we realize is potent, but we do sincerely desire to draw a common-sense line of demarcation between inadequate physical causes and physical integrity. We do not believe that the combined experience of all investigators will show that a physically perfect individual reacts in an extraordinary way to ordinary injury. Exaggeration of symptoms seems to be prominent not only in hysterical and neurasthenic trauma, but also even in ordinary injuries; there seems to be a tendency to make injuries occurring upon railways much worse than those occurring under other circumstances.

While this may have its origin, in many cases, in the hope of future compensation, yet oftentimes the very element of exaggeration is indicative of the effects of psychic trauma. Page expresses this very well when he says: "If, as it has been said, the motive is so strong and so prevailing, it is natural and only human that exaggeration should be met with in a large proportion of the cases injured in railway accidents. But, on the other hand, it must be remembered that exaggeration may not be, nay, very often is not, altogether wilful or assumed. Exaggeration is the very essence of many of those emotional or hysterical disorders which are so common in both sexes after the shock of collisions. Here it may be an idiosyncrasy of the individual; there it may be the outcome of mental disturbance from the fright and alarm amid which the injury is received. It is only by a consideration of every feature and aspect of the case—clinical, pathological, social, and moral—that you can rightly estimate the kind of exaggeration or malingering with which you have to do."

DEFECTS OF VISION AS A DIAGNOSTIC SIGN.

In traumatic neuroses arising from railway injuries, the concurrence of opinion plainly points to the fact that while functional eye symptoms arising therefrom are very generally present, it is extremely rare to have them followed by any organic change. These functional troubles undoubtedly constantly partake of the nature of hysteria and neurasthenia, and they are emphasized in proportion as the well-marked elements of both of these conditions are present. English authors stubbornly deny that there are any definite changes which can be considered as occurring regularly in the eyes after railway injury.

Thus, Dr. Byrom Bramwell said that changes in the fundus oculi are said to occur after railway accidents. The optic disc was said sometimes to be altered in appearance. In his experience this did not occur. Dr. Clifford Allbutt regarded atrophic condition of the optic nerve as possible, but this symptom must not be made too much of, in consequence of its infrequency. Dr. Buzzards states that he has never seen optic atrophy after railway injury.[1] It is hardly necessary to quote further, except to mention the fact that both Thorburn and Page are in unison with the views above mentioned.

Among functional eye symptoms, special modification of the field of color vision is usual, but it is not always present. It is considered that the size of the pupil affords a reliable evidence as regards the nervous condition of a patient suffering with traumatic neurosis. The condition of the pupil varies, transient differences in its size existing at times, necessitating more than one examination. Dilatation of the pupil indicates, according to Page and others, a lack of nerve-tone, while the converse, a small pupil, is a rare accompaniment. As averred by Page, this symptom is simulated now and then by the introduction of atropin in the eye. Photophobia is not considered a constant symptom, but for the most part occurs where we have well-pronounced psychic shock, but, as a rule, it is transient, existing only during the time of the full manifestation of shock.

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[1] New York Medical Record, *loc. cit.*

It has been asserted by competent observers that light of only medium intensity should be used in examination of the eye. Guillemand says: "As to the enfeeblement of the visual acuteness, diplopia, and strabismus, although they can be vigorously imitated by a patient well versed in the disease, still they are useful to us, for it is rare that they are known to the individual submitted for our examination." Narrowing of the visual field is one of the signs which has served most often to disprove the simulation of which a patient has been accused. Probably no symptom in the entire discussion regarding traumatic neurosis has received more attention than contraction of the visual field, predicated upon the fact that it is considered to be the most valued and constant symptom to prove this condition. Oppenheim says: "I have particularly noticed this sign, and never neglect in important researches to make careful perimetric examination, and even to repeat it several times. I have arrived at the conclusion that concentric contraction of the visual field is found in a great number of cases. When I found it in a minor degree, although it was certainly pathological, I allowed it significance only if it was constantly shown, and if it was found on the same side of the body which was injured. As a proof of simulation, it is said that in certain cases the visual field during the examination at different distances does not show the variations which ought to be expected as corresponding to the opening of the angle. But this assertion rests on a wrong idea. Restriction of the visual field in functional neuroses, just like their symptoms, are governed by laws different from those imposed in diseases of the brain having an organic origin. Thus, for example, a person who has only seen ordinary hemiplegias will, as a result, think everything simulation if for the first time he examines a hysterical hemiplegia."

It will not be inapropos at this juncture to cite the case of a patient who was supposed to be suffering from traumatic neurosis. This case was sent to the oculist without any previous explanation, and his report follows:

"I did not ask a single question about his symptoms before proceeding to measure his visual fields. The left visual field, except for a slight contraction—the nose notch does, of course, not count—is virtually normal, and denotes absolutely nothing. This was the eye I examined as the second one, and I was almost convinced that he thought he was gaining something by stretching his field a little. The field of his right eye, which I examined first, shows quite a number of contractions, irregular in shape, still in general concentric. This is the eye which has also a little less visual acuity than its fellow. In both the visual acuity is below normal.

"But now comes a point which may explain these symptoms without evidences of traumatic neurosis. This man has a lot of posterior synechiæ which refer most probably to a former iritis, although in the left eye there is a considerable amount of pupillary membrane adhering to the anterior lens-capsule. The condition might perhaps be a fœtal remnant. Ophthalmoscopically his right papilla showed quite a marked capillary hyperæmia, while in the left eye this was less marked. The retinal vessels were anæmic. This condition is most frequently found in alcoholics and heavy smokers. Having made these examinations, during which he would, with singular alertness, sit down, get up, turn around quickly in the dark room, etc., I questioned him regarding the case from an historical point of view. I heard now that he claimed to have been blind for a time during his illness (this was a lie, as he had never made any assertion to any physician in hospital or to any one regarding this condition). You see, my dear Doctor, I have examined this man totally unbiassed. Neither does he know what I did, nor what I did it for, although he was not only eager to have me tell what I had found—in fact, I had quite a discussion with him about his right to know what I had found—but he also wanted to carry my letter to you, and stated that to-day it would be too late. The condition of these eyes, then, does not, I think, prove anything for traumatic neurosis. My personal conviction, which, of course, does not go for much, is that the man is neither a total malingerer nor a school example of traumatic neurosis. I should like very much to examine his eyes once more with you personally present. ADOLPH ALT, M.D."

The reason we introduce this examination is to indicate that under ordinary circumstances an imperfect examination would probably have indicated contraction of the visual field. But the previous vision shows that contraction was attempted, and was not the result of his injury.

This individual was injured by being caught upon the pilot of a locomotive going at a rapid rate, and thrown some fifteen feet in the air over a passenger-coach. He was completely turned over in the air and alighted with his buttocks upon a pile of lumber some twenty feet distant. While he was a little dazed, as he expressed it, at the time of the accident, yet he clambered down and averred he was not much hurt; and he continued work for some two weeks before any trouble was manifest. He had an alcoholic history, and was an excessive consumer of tobacco. All through this case many of the plainer evidences of traumatic hysteria were more or less present. He had the fibrillary tremors of face and hands; he had periods of hyperidrosis; his pupils, of course, were contracted incidental to a previous lesion. Hysterical seizures were never manifest until the ninth month after his injury. He was able to balloon his abdomen any time he desired. This was done upon all occasions when he was observed. His face always presented an unwrinkled front; while pale, it was never pained nor pinched with care. He had a monoplegic right leg; the foot was dragged true to a case of this kind. He claimed an inability to perform co-ordinative motions, but this was unfounded, for he could perform many. There was never any marked disturbance of circulation. There was more or less progressive improvement as regards the accumulation of flesh. After he became able to walk with crutches, he always stood in a classical attitude, the affected limb being held up while supporting himself on crutches. Told to walk without crutches, there was an utter inability to accomplish this act, which was plainly not the work of a malingerer; there was every indication of positive fright and apprehension with incoherence of movement, an effort too intense and reckless to be simulated by any one.

Notwithstanding the fact that this individual received compensation, and now walks apparently very well, we are thoroughly convinced that this was neither a case, as expressed by Dr. Alt, of total malingering, nor a school sample of traumatic neurosis, and the resultant of traumatism along with a predisposition, namely, alcoholism.

Continuous discussion has been indulged in regarding the value of this symptom to disprove simulation. Many writers assert that its value has been overestimated; some believe that it can be simulated; others that it is a typical hysterical symptom, and not to be found in a neurasthenic condition. Willibrand asserts that, by varying the examination, simulation may be excluded. Bruns argues that some place the cases as described by Oppenheim on the same plane with those of simple neuroses, in which visual narrowing must be expected, as the trouble is not central. Such cases have brought about great confusion. Eisenlohr takes the same stand. Again it is asserted that upon repeated examinations the patients become educated and are competent to simulate this symptom. According to Guillemand, Wallenberg says: "If in the case of hysterical patients with contraction of the visual field we draw this visual field on a chart, and if then, by progressive removal of the patient, we augment the distance of fixed points, we observe, in most cases, a slow but perceptible increase of the field, which in most cases is not in proportion to the increased distance. In certain cases even these limits do not change."

Certain it is that there are elements of confusion as regards this symptom; the same condition of vagary surrounds it that surrounds the consideration of any single symptom. It would certainly appear to be pre-eminently common sense at all times to properly group the various symptoms, both subjective and objective, giving each its proper and respective value. We have seen cases of traumatic neuroses which have been diagnosticated almost entirely upon the presence of visual contraction and the Mannkopf sign.

THE IMPORTANCE OF A COMPLETE HISTORY OF CASES.

The full history of a patient is of paramount importance to the physician. It is with knowledge thus thoroughly obtained that satisfactory diagnosis is accomplished, treatment rendered intelligent and judicious, and prognosis made reasonably sure; and thus the competent physician is enabled to fulfil the highest and best function of his calling. It is particularly necessary to note every incident in connection with the case, taking especial note of the character of the patient, and the presence of any scars, deformities, or other marks which existed prior to the beginning of the trouble under consideration. Indeed, we have found it of especial value at the first examination to have every point carefully written down, and no element of history left out. An imperfect history, particularly in traumatic neurosis occurring after railway accidents, certainly robs the expert of the very points upon which his deductions should be based.

As a rule, the fact of a person having been a passenger on a railway train in an accident is taken as sufficient evidence and cause for the production of traumatic neurosis. It is rare, indeed, for the expert to take any other statement than that of the patient regarding the manner of the infliction of the injury, even though he knows—none better than he—the extreme and thorough unreliability of statements made by neurotic individuals. There may be justification for this in the accepted idea that it will not do to conclude that the blow should be severe to produce permanent injury. It is conceded that seemingly slight

THE DANGERS OF LONG-CONTINUED AND MULTIPLE EXAMINATIONS.

In examining patients really suffering from traumatic neuroses, too little judgment is often used regarding the length and exhausting influence of the examination. The expert in his eager devotion to his calling not infrequently prolongs his examination to such an extent that harm is produced. We have seen examinations made which would tire a strong man. Hence, we maintain that no examination of a case of this character should be made long and exhausting; nor can it be made in one day. The expert should proceed with all due caution, and aim to study, as near as possible, first, the mental condition of his patient. The results of each examination made should be noted, though but little be accomplished at each sitting. Due consideration for the patient's feelings will certainly render more plain the condition of the patient than when the matter is overdone. Exhaustive examinations frequently mask or intensify symptoms. We should always bear in mind that the disease receives at least some of its nutriment from suggestion; and suggestion may come not alone from words, but from the actions of the examiner himself. We do not believe that any individual poorly posted as a physician should attempt an examination of these cases. From experience, we have arrived at the conclusion that multiple expert examinations are prejudicial: we do not mean many examinations by the same observer, but multiple examinations by specialists. Thus, upon more than one occasion, desiring to be unprejudiced, and hoping to get intelligent assistance, we have sent our patient to the oculist to have his eyes examined; to the aurist, and the heart and lung specialist. And we have invariably found that the tests which were employed by these various specialists did little to elucidate or unmask imposition, if such existed, and in cases of true traumatic neurosis our patients were left in a much worse condition. Certain it is that the suggestions received in these cases by the multiform examinations rather clouded than cleared the case under consideration, producing confusion, not only as far as the psychic condition of the patient was concerned, but as far as the physicians themselves were concerned.

The patient's statements, when taken down, not infrequently make an accurate history of conditions which he could not describe unless he had been thoroughly posted in a neurological way. Many persons attempt to read up on the subject; and in our experience we have met with several who were comparatively well posted. Among the latter was a lady who had become a very good student of Erichsen, especially in his statements of the amounts awarded as damages. In the discussion during settlement with her, poor judgment allowed her to indicate the number of pounds which had been paid in compensation upon such and such an English road, by which she desired to draw a comparison to show that the compensation offered her was inadequate upon the basis of English compensation.

It will be found that attempts to educate lady readers upon this subject are a good deal like attempting to make a competent surgeon out of an engineer; that is, it is impossible to make a scientific person out of an unscientific one by the simple reading of a book.

In our experience we have never had any difficulty in dealing with persons of this character. The true line of honest, unprejudiced investigation based upon the scientific data seems at all times competent to expose them. We believe, with Oppenheim, that all kinds of disturbances of the mind can be simulated. "The theatrical presentation of Lear, Ophelia, and others have proved this. In spite of this fact it will not enter the mind of anybody to refuse the value of objective symptoms among the signs of the psychosis. Good actors are very rare, and have acquired their merit only after long, laborious, and deep study. Among artisans and laborers, I do not think there is anything more difficult to simulate, even approximately, than psychical disease."[1] All authors direct that leading questions should be avoided, as suggestions are received with unusual rapidity, and interpretations of them are sometimes made by the patient that indicate an astounding activity of mind. Where a question can be avoided, it should be at all times done; because the unstated evidence presented is of more value than when stated by either a weakened intelligence or the acumen of a malingerer.

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[1] Oppenheim on "Simulations in Traumatic Neurosis," Berlin, 1891.

It is useless at this time to give the various pathological gaits described by authors, as they have been partly considered in another section, and as many may arise from more or less pretence or exaggeration dependent upon psychic peculiarities of the individual. As a rule, the legs are spread wide apart, with cramped, short, slow steps, and with lessened movements of some joints. Oppenheim says: "From the superficial resemblance of the gait to that of spastic paresis, we are able to make a differential diagnosis. There is an abnormal position of the body; in the fixed spine and forward trunk flexion commonly one hand is held on the sacral or hip regions." In unilateral paresis, the gait disturbance is one-sided, the patient supporting himself on one leg or with a crutch, while the other is completely motionless, suspended above the floor; the foot touches, and is dragged along.

In an endeavor to elucidate the existing soreness and rigidity of the back, which is considered as being the controlling factor in gait and attitude, it is proper and important to determine the exact condition of the back. In sixty per cent. of these cases arising from railway injuries, back symptoms are complained of.

F. X. Dercum has done much in this direction; we shall not apologize for freely quoting him in regard to the proper and true method of making these examinations. Briefly condensed, his method is as follows: Note is taken of the position in which the back is held, observing whether the shoulders are held on the same level, the presence and relative amount of curvature, and the existence of muscular tremors. The first test is by palpation, where the hand is placed lightly upon the back of the patient, observing whether the patient shrinks or not. This may indicate either the absence or presence of hyperæsthesia, or a disposition to simulation. He says that if hyperæsthesia is present it is highly probable that hysteroid symptoms will be found in a further study of the case. The value of hyperæsthesia as a symptom he considers very small. The second test is by pressure, which he divides into deep and superficial. In superficial pressure the finger-tips or the palmar aspect of the thumb are used; graduating the pressure used, it is passed up and down the spinal column. This test, as is well known, may elicit in certain cases flinching or other reaction, as though pain was experienced, especially when pressure is made over the lower cervical, mid-dorsal, or dorso-lumbar regions, over the lumbar region itself, or over the end of the coccyx. This symptom, as he states, is commonly found in neurasthenia, especially in that form known as spinal irritation; and it may be found when hysteria accompanies neurasthenia. The next test is deep pressure by the thumb, stress being laid upon the application of its palmar aspect. The degree of force is varied as desired. The soreness present, when elicited by deep pressure, is generally more diffuse, and may be found on both sides of the spinal column, or even over various muscles of the back. When the desire is to elicit pain, not by force of blows, but by a faint and yet decided jarring, the percussion hammer is used for striking a number of very rapid, but not hard, blows on the spine of the vertebræ. Next the test by motion is used, which is divided up into voluntary and passive motion. The patient is made to bend forward toward the observer, and the manner in which the act is performed is noted, at what stage of the flexion pain occurs, and whether muscular spasm or rigidity is excited. Then the patient is caused to perform lateral flexion. When there is doubt, the trunk is forcibly flexed to the right or left side, without warning the patient. In another test used, called forcible rotation, an assistant kneels before the patient and firmly grasps his hips, while examining surgeon gently rotates the shoulders, thereby rotating the upper half of the trunk, to elicit evidences of deep-seated soreness or not. This is considered a very powerful test. Having failed to elicit any response up to this point, transmitted shock is applied. The patient is made to interlock his fingers upon his head; then by a sudden downward pull an impulse is sent through the spine. Of course, good judgment must be used as regards the amount of force exerted. If it is desirable to eliminate the cervical portion of the spine, the patient may be seated and the impulse transmitted through the shoulders. Another test, which is less valuable than the others, is causing the patient to raise himself on the toes and then let himself fall heavily back on the heels.

While generally commending these tests as given, we cannot but think that they should be used only by the competent specialists. Again, any one who has made a study of this subject realizes that these examinations, particularly of the back, should be made with the utmost caution.

LOCOMOTION AND TESTS FOR CO-ORDINATION.

The multiplicity of tests which are used in attempts to verify diagnosis are useful at times, if followed out legitimately; but undue rapidity creates confusion. We do not believe that it is either sensible or proper, in the application of these tests, to take one examination as the sole criterion. Frequent comparisons should be made. Muscular power may be found to be more pronounced on one day than another; yet this variation does not by any manner of means indicate pure simulation.

It is only a just comparison and study of the objective symptoms and their blending with subjective symptoms that can lead us aright, and we believe the simplest tests are always the best. Those which are naturally performed by the patient, and without too much display, are to be preferred. We should particularly notice the manner in which a patient walks where extra muscular exertion is demanded, as in ascending and descending stairs. A comparison should be made as regards the degree of motor involvement; the amount of possible flexion, extension, and rotation of the joints of the inferior and superior extremities should be observed, aiming to determine what relative differences in the muscular use of the respective sides exist. The manner in which the patient rises from a sitting posture should be noted; if he uses his arms as a support, he should be made to rise from his seat without the aid of hands and arms. It has been suggested by Clevenger and others that a powerful test is made where the patient is directed to assume a supine position, and then made to rise without the use of his hands and arms.

The best test to determine the degree of the ataxic condition of a patient is to cause him to walk along a straight line with his eyes closed. Generally, persons in health can accomplish this with ease, while ataxic individuals try to protect themselves by throwing out one leg to maintain their equilibrium, or a very pronounced form of staggering is observed. Again, the patient's ability to stand with his toes and heels together when the eyes are shut should be tested to determine the relative degree of swaying from one side to the other. While this may be readily simulated, yet at the same time a relative idea may thus be had as regards the patient's ability to do this.

In testing the ataxic condition of the upper extremity, a test which is generally used is to make the patient shut his eyes, and with a long swinging motion of the arm he most uses, be it right or left, attempt to touch the tip of his nose or the lobe of his ear with the forefinger. In the act the relative degree of muscular inco-ordination is shown by the degree of uncertainty and wavering, or failure altogether to accomplish the purpose. The patient's writing may be examined to test the state of the extremity used. Though deficiency of muscular strength may be simulated perfectly, yet variations in this respect may constantly be discovered and very nearly correct conclusions arrived at with proper care.

Page writes much upon the abuse of so-called instruments of precision, and avers that they are more harmful to the patient, in consequence of their suggestive character, than they are helpful to the person examining. Gray asserts that the dynamometer is unreliable, and that he immeasurably prefers the hand grasp. He deems it more reliable in every direction, since the observer interprets by means of the sensation in his own hand. The patient should be made to grasp the examiner's hands over the knuckles and not above. Obviously a better idea of muscular strength can be thus obtained than with an instrument that varies in its results and is defective in construction. When using the hand-grasp, the patient can generally be made to use opposing movements; by talk and bantering a patient can often be made to indicate the actual degree of his muscular power. While only a comparative idea can be gained in this way, still it is infinitely better than to use an instrument whose indications are even variable in normal states, and rarely ever tell a truthful tale. Should it be desired to use different weights, the lighter should be first employed, progressing to the heavier. We have been accustomed to use a two-gallon bucket, and by filling or emptying this, an approximate idea of the muscular strength of both upper extremities can be obtained. The consistency of the muscles should be tested by feeling them during contraction and relaxation. Differences in size between the two sides, keeping always in mind whether the patient is right-handed or left-handed, should be noted.

The vasomotor condition, particularly of the involved extremities, should be studied. There may be a cyanotic condition of the skin of the affected side. Any difference in temperature between the healthy and involved sides should be noted. Œdematous swelling of the parts should be looked for; this symptom is more frequently found in the lower extremity than the upper. Œdema, cyanosis, and lowered temperature are especially valuable signs, though even these may be induced or intensified for purposes of simulation. Thus, in one case where an individual presented but slight evidences of œdema and cyanosis while in bed, after wheeling around the ward during the day in a wheeled chair, the cross-beam of which rested directly under the bend of the knee, at night the œdema and cyanosed hue and the cold feeling of the cutaneous surface were increased, showing plainly that physical conditions had intensified them. This patient had been under examination some four months and a half. He had perfect control of his feelings, for the various tests used indicated complete anæsthesia; but upon settlement all these symptoms disappeared with remarkable and unusual rapidity.

While examining the patient it should be noted whether excitement is engendered or not; whether redness suffuses the face and the upper parts of the chest in a series of flushes. At the same time it should be noted whether there is indication of impaired nerve function as shown in hyperidrosis. Guillemand says: "The weakness of the vascular tonus depends on weakness of the nervous vasomotor system, which reveals itself by a number of objective symptoms, easily appreciated even by an observer of small experience. We refer to the sudden intense redness which invades the face, the forehead, the ears, and the chest. It begins with a small red spot, which rapidly spreads and forms a kind of roseola, justly called emotional roseola. Belonging to the same class of phenomena, Oppenheim notes the occurrence at each excitation of the injured side of the body, besides dilatation of the pupil, a redness of half of the face, and not a pallor, as some claim."[1]

DISTURBANCES OF THE SPECIAL SENSES.

Disturbances of smell, taste, and hearing, being entirely subjective in character, are not considered of great diagnostic value, owing to the constant difficulty of proving or rather excluding fraud, unless previous acquaintance with the patient debars the possibility of it. Tests made to determine their involvement are generally unsatisfactory, as they depend mainly upon hearsay testimony.

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[1] Guillemand, *loc. cit.*

Subjective sounds, such as whistling and buzzing in the ear; unusual acuteness of hearing, even to the most insignificant of noises, such as the ticking of a watch or clock, and various degrees of deafness are complained of.

In four cases of deafness occurring in cases of traumatic neurosis three admitted having been previously deaf, but stated that they were rendered much worse by the accident (Thorburn).

DISTURBANCES OF THE CIRCULATORY SYSTEM.

The disturbances of the circulatory system are of great importance. Usually they are not directly under the will of the patient, though they can at times be more or less influenced by the will. While certain circulatory changes can be voluntarily induced, still the grouping of the various circulatory phenomena may be of great diagnostic value in the determining of a true case of traumatic neurosis. The influence of fright, particularly where it is severe, is manifested at once upon the heart, inducing what is termed "shock." As Page expresses it, cardiac paresis is manifest from the beginning, and is plainly the result of shock. Thus, under such circumstances, we find an enfeebled organ trying to make up in rapidity of beat what it has lost in force; there is a quick, rapid, feeble pulse, without tone, without strength. If this original state of shock continues, a paretic condition of the heart is produced which predisposes to frequent attacks of excessive palpitation. Thorburn, referring to vasomotor, trophic, and secretory symptoms, says that they are much less common than the sensory and motor phenomena of traumatic hysteria; but he believes, nevertheless, that we do meet with such symptoms due to hysteria, and to hysteria alone. It is equally true that they are at times entirely dependent upon a neurasthenic condition. Patients complain of palpitation from the most trivial causes of excitation, which induce a frequency of pulse which may vary from 100 to 160 per minute. In the examination of patients it is always important and proper to use systematic means of determining the exact condition presented. Thus, as pointed out by Page, when the pulse is counted at the beginning of an examination, never fail to count it at the termination of the same; for by this means we are enabled to ascertain whether there has been any variation in the interval. In fact, where examinations are made repeatedly, it is always well to start with the pulse at each examination; for by any extended course of examinations involving weeks or months, the pulse may afford an indication of the relative degree of improvement in tone of vessels which will constitute a basis for just compromise. When we find that the heart-beat is essentially the same whether the patient is in a completely quiet state of mind and body or not, we can draw our inference. But, as stated by Page, a perfectly steady pulse through the whole examination tells its own tale. In the process of our examination, if we find that fatigue and emotion influence and aggravate this condition, it is certainly more or less indicative of a neurotic condition. The rate and character and excitability of the pulse indicate the amount of disturbance of the strength and tone of the nervous system, and at times constitute the best signs by which to estimate the patient's actual condition. An antecedent history regarding the patient's circulation before the examination is an essential part of the history. The whole vasomotor system at times seems to be deranged, and hence to have lost its normal tone; and, as we have previously indicated, peripheral manifestations are important. Patients not infrequently complain of these disturbances, flushings, the alternate feelings of heat and cold, not only about the face and head, but in various portions of the economy. We shall not again refer to the diagnostic importance of the vasomotor conditions of the paralyzed extremities, which are manifested in cyanosis, differences of temperature between the normal and injured sides; but it may be said that, as a rule, in the parts over which will power is lost œdema occurs, as in one case of ours where both extremities of one side were more or less œdematous.

FIBRILLARY TREMBLINGS OF MUSCLES OF FACE, AND THEIR INFLUENCE ON SPEECH.

It has been asserted by Clevenger that fibrillary twitchings or tremors of individual muscular bundles cannot be simulated.[1] When these are confined to the face, they become particularly noticeable; those around the lips or eyes presenting a tremulous aspect, especially obvious when the person is agitated or tired. They seem to be under the influence of the emotion, and are always lessened when the attention is withdrawn. They are not confined to one side, but may appear stronger in either one extremity or the other. When the right arm is the seat of the tremor the writing of the individual is affected thereby, but then the test of writing is one of the most inconstant signs. These tremors, at times affecting, as we have before stated, the facial muscles, not infrequently involve the lingual muscles, causing more or less difficulty in speech. Simulation of speech defects is possible, and should not be regarded as always of absolute diagnostic value. Still, a careful study of them should be made if they are present.

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[1] "Spinal Concussion," by S. V. Clevenger. F. A. Davis, Pub., Phila., 1889.

There may be slowness and difficulty of utterance; it is not infrequently scanning in character, uttered with slowness and difficulty; or utterance may be explosive. Again speech may be accompanied by deep inspiration or panting, as if fright or intensity of effort had induced a rigid condition. Stuttering itself is not infrequently found in these cases.

DIGESTIVE DISTURBANCES.

Digestive disturbances frequently supervene almost immediately after the accident, and may persist for a long time, or become the focus of a chronic condition. They are especially gastric in nature. Nausea and vomiting may continue with oppression after eating, pain in the epigastrium, and other symptoms pointing to disturbance of the innervation of the stomach. The tongue becomes coated, and at times thickly furred; constipation seems to be the rule, but at times the reverse of this may occur, in which diarrhœa or symptoms of relaxation are manifested. It has been asserted by Guillemand that pronounced and inveterate constipation is an unfavorable sign; it aggravates the neurasthenic dyspepsia, and renders the treatment more difficult and uncertain. General nutrition is positively interfered with, and strength is sensibly diminished. Emaciation occurs, along with which there is pallor. The general condition of the patient at times seems pitiable, indicating excessive functional trouble. The muscles become flabby; vasomotor disturbances are manifested in persistent coldness of hands and feet. According to Guillemand, Bouveret divides the gastro-intestinal atony of these cases into two classes, the benign and the grave. The benign form is that where general nutrition does not seem to suffer, and the subjective sensations are summed up in the idea of weight, fulness, sluggishness, cramps, and a ballooning of the epigastric region and hypochondrium. In the examinations made after a repast, gaseous distention of the stomach frequently occurs. There is not only meteorism of the epigastrium, but a gaseous resonance beyond the physiological limits. Upon exploration of the gastric contents by means of a tube, we find a notable diminution, or even a complete disappearance, of free hydrochloric acid during the whole time of digestion. He avers that complete absence is more frequent in the truly neurasthenic patient. The contents of the stomach are generally composed of mucus, meat, and bread. Two or three hours after the beginning of digestion there is the odor of butyric acid, and the stomach seems to empty itself very slowly. Not less than six hours after eating, it is found empty. In this first degree the secretion is more at fault than the movements of the stomach, and, to use his own words, this general anachlorhydria is rebellious.

In the grave variety, nutrition is more profoundly affected; strength is almost lost; pallor and emaciation supervene; the skin becomes dry and of an earthy color; the face languishing in expression. The wasting at times may remain stationary, or even increase, during many months in spite of treatment. Amelioration is very difficult and slow, and relapses occur very easily. This is the period in which the patient is tormented by vivid hypochondrial prepossessions. Upon analyzing the gastric contents the same results are found, only that secondary acid fermentations are more pronounced. The secretions suffer, and there is atony of the stomach which seems to be peculiar to this variety. Even six hours after meals food is still found in the stomach. The muscular coat of the organ and its walls yield, and the cavity dilates; in fact, a splashing stomach-sound may often be obtained several finger's breadths below the umbilicus. The great curvature of the stomach may mark itself on the emaciated abdominal walls, producing a fold of skin at variable distance between the umbilicus and pubes. Guillemand names three complications of the grave variety: first, pseudomembranous colitis as a consequence of constipation and atony of the large intestines; second, dilatation of the stomach; thirdly, enteroptosis, of which the symptomatology is well known. This appears to be more frequent in women than in men. In the former it is necessary to add to the manifest influence of emaciation and gastric dilatation, relaxation of the abdominal wall and of the suspensory ligaments of the viscera, the predisposing causes of which are repeated pregnancies and the wearing of very tightly drawn corsets. It is well known that these two latter influences would suffice to produce the trouble itself. Emaciation, constant lack of appetite, gastro-intestinal troubles, vascular disturbances, and psychic anomalies certainly attest the reality of the affection.

The general disproportion here between the objective and subjective symptoms, while having no real value for the discovery of simulation, will certainly put the expert on his guard.

THE TESTS OF SENSIBILITY—THEIR VAGARIES.

Oppenheim states that contradictions in the examination of sensibility are always found, because we do not examine with an excitant of a uniform intensity, and because the attention plays a constant and important part. Cutaneous anæsthesia, according to Hirt,[1] varies in its seat and extent so much in the same individual that frequently repeated examination may give different results. Again, according to Oppenheim, in irritable persons where attention is quickly fatigued or weakened, the same stimulant in the same place during the same examination is not perceived, or perceived in an intense manner, according to the attention paid by the patient. Thus, for example, a patient who does not feel pain as a result of a prick capable of producing it, and who under the same influence has no reflex movement, may at another time react violently at the same point. Simulation is not necessarily indicated by this.

In the line of this last assertion, a case of so-called traumatic neurosis is in point. Under examination a pin was thrust into the thigh, and a very prompt reflex followed, the movement thus excited being not less than a foot in height. The following were the conclusions drawn by a professional *confrère* to disprove that there was any element of simulation present: "The results obtained by the pin experiment certainly prove that serious destructive myelitis existed, preventing, so far as could be determined by the doctor, any sensation of pain. When the pin was thrust into the patient's leg the exalted reflex gave a movement, as stated by the doctor, of about one foot in height. This is exactly what might be expected when we reflect that the reflex centres were no longer under the inhibitory influence or control of the will." This patient had, for four months after an injury, been in a paraplegic condition. At no time during these four months had he been observed to move his inferior extremities. The lower extremities were cold and cyanosed. Here were conditions which plainly pointed to organic lesion. He settled with the company in the forenoon, and left on the evening train. He lifted the leg up which had not been lifted for four months and put it on a valise in front of him. On arriving at his destination, he walked out of the coach unassisted, and from that day to this he has never had any symptoms of paralysis.

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[1] "Diseases of the Nervous System," *loc. cit.*

Notwithstanding the seeming difficulty attendant upon determining conditions of sensibility, their many contradictions and their confusing elements, yet, if considered carefully and calmly, they tell a great deal. Goldscheider[1] recommends the following plan of deciding between actual and feigned analgesia or hyperalgesia. The indifferent electrode attached to a faradic battery is a large metal plate, and the other a long wire brush, the latter being placed in such a manner that half the length of the brush rests on the unaffected side, the remainder upon the part said to be numb. With a current strong enough to cause pain, the electrode is slightly raised from the normal side without the patient's knowledge; cessation of pain necessarily follows if the skin still in contact with the electrode is analgesic. Gray[2] well summarizes regarding the senses of touch, pain, and the temperature, and we cannot do better than to quote him. He says: "In testing the sense of touch, the ordinary method of employing rough and smooth objects and an æsthesiometer will not exclude simulation. The test by means of a pin or other penetrating object is not a test of the sense of touch, as it has been assumed to be in so many trials, but really of the sense of pain; and this is also true of the test by means of the powerful faradic current.

[1] Annual of the Universal Medical Sciences. F. A. Davis, Phila., 1893.
[2] *Loc. cit.*

The best medico-legal test of the sense of touch known to me is to lightly touch the patient upon the alleged anæsthetic area when his attention is diverted, or when his back is turned, due attention being paid to differences in tactile sensibility normally existing in the different areas of the skin, and to any possible marked degree of mental dulness. This simple test is extremely effective, and I have never known it to fail, even with the best-informed malingerers; and it is especially useful in alleged hyperæsthesia. The best test for the sense of pain is a powerful faradic current. A very gentle current should first be applied, and should be gradually and carefully increased to a moderate degree, so as not to alarm the patient; and then, the physician's hand having been all the time kept on the current regulator, a powerful current should be suddenly turned on. Some means of measuring the strength of this current should be employed, so as to be able to reproduce it and allow the jury, if necessary, to test it for themselves. The strength of the current that is to be used should always be determined before the examination, so that care may be exercised to employ no more than will be necessary to cause a distinct and not extremely painful sensation. The test by means of a needle is extremely unreliable, even though that needle be concealed in the so-called *aigue-cache*, or hidden needle; for we must remember that hypodermic needles can often be thrust for inches into the tissues without exciting pain; so that it is a very easy matter for any determined person to accustom himself to burying a pin in his flesh, as is often done in jest by boys. The exact position of the alleged pain, and the attitude and gait, are frequently of great importance. If the patient marks out the pain in the distribution of a nerve, this is strong confirmation of the truth of his statement, although the converse of this proposition does not follow; for pain is often vaguely distributed in indubitable disease, so that the positive value of such a statement is great, while it has no negative value. The presence of the characteristic attitude and gait of sciatica and of traumatic neurasthenia, as it has just been delineated, would be of great value.

" A very efficient method of testing the temperature sense is as follows: The patient should be blindfolded; a tumbler or test-tube should be filled with cold water, a second with moderately warm water, and a third with water so warm as to be slightly painful but not to scald. The glasses containing the cold and lukewarm water should then be applied in succession to the portion of the skin to be tested, and the patient be asked to state which is the cold and which is the lukewarm. This should be repeated several times, when, if the patient has failed to distinguish the temperature of the water in the two glasses, some of the very hot water should be suddenly spilled over the alleged thermo-anæsthetic area, care being taken not to spill any water upon any portion of the skin that has not been alleged to be affected.

"I know of no test of the muscular sense that will positively exclude simulation. When a patient alleges that the sense of pain, the muscular sense, or the temperature sense is alone affected, while no claim is made as to any implication of the sense of touch, this would argue strongly against simulation; for any malingerer, except one versed in nervous diseases, would be most likely to insist upon impairment of the sense of touch. It should also be borne in mind that these four different senses may be affected in different diseases, either singly or in conjunction with one, two, or all of the others."

THE MANNSKOPF SIGN.

Rumpf, of Marbourg, has suggested the use of the Mannskopf sign for the verification of real neuralgia or tenderness.

When pressure is made upon the painful or tender region the patient's pulse grows more rapid in a few seconds, rising from 84 or 92 to 100 or 120 beats per minute. This increase lasts for two or more minutes after pressure is stopped; besides, the pulse becomes smaller during the test. He found this present in eight cases of traumatic and in four cases of non-traumatic neurasthenia, absent in none, and he claims to have detected one malingerer by this means—the pulse did not rise during the test and the patient confessed later. He proposes to call this the neuralgic or traumatic cardiac reaction. Secondly, he uses quantitative reduction of galvanic excitability of motor nerves. Thirdly, faradization of the nerve trunk, fibrillary contraction of the muscle being found to last some time after the operation. He states the number of true neuroses is small; more than thirty-three per cent. are hysterical, ten per cent. are malingerers, and not more than five per cent. suffer from permanent disease.

Regarding the value of the Mannskopf sign, we are free to confess that we have met it in conditions where psychic troubles are not manifest, and we think that it will be found to exist particularly in cases of subluxation of the vertebræ.

THE INFLUENCE OF COMPENSATION UPON THE CLINICAL FEATURES OF RAILWAY INJURIES.

The influence of compensation upon personal injuries arising from railway accidents varies with the individual. The hope and surety of compensation might possibly arouse in one man a spirit of inactivity, in another the reverse. Page, in the consideration of the influence of compensation after railway injuries, says: "Suppose, however, that compensation is to be awarded for every ache or pain and for every day that he is absent from his work, it is only natural that the keenness of his desire to resume work should be very much diminished. If our hospital patients were to be compensated, we may be sure that the features of many a case would be completely changed, and that the whole clinical history of a disease would wear a very different aspect from that which is usually seen; and changed for the reason that compensation acts as a let and hindrance to the natural and the very necessary effort which each person must make for himself toward convalescence and resumption of work. It may do so quite unconsciously; for the knowledge that compensation will certainly be paid him for the injuries sustained in a railway accident tends from the first day of illness to give a tone to his feelings and to effect his own impressions of the sufferings which he may have to undergo. He is less likely to take a hopeful view of the future, is more prone to be despondent about the prospects of his recovery, and in so much will his own personal efforts be weakened. It is well that this matter of compensation has no place in every-day hospital practice; and you will always do wisely, in endeavoring to form an estimate of the cases which involve medico-legal inquiry, to revert to your hospital experiences, and to recall the usual history of your hospital patients, both as to suffering and disablement and the prospects of recovery."

We cannot agree with the idea in general. Any one who has had experience in this class of injuries in this country has learned from daily contact and treatment that more or less exaggeration enters into any case; it would appear to be nothing more nor less than human. But how the soothing elements of an assurance which certainly placates irritating circumstances can in any manner hurtfully change the clinical aspects of any case, we cannot clearly see. The writer has for years been in charge of a hospital wherein every injured patient has, from the time of his entering into hospital until cure, the assurance of more or less compensation (these patients numbering hundreds annually); and if it could be computed with absolute correctness, it would be found that, as an element aiding cure, its efficiency is as great as almost any factor in the treatment. Take as an illustration the laboring class, the employees of a railway. It is an almost invariable rule that they belong to some benevolent or protective organization which gives compensation during disability. Aside from this, compensation is paid them by the railway company for damage inflicted; and yet the mental tone created does not superinduce except in the rarest instances inactivity and turpitude, nor unduly exaggerate the term of prospective disablement. Granted that in isolated instances the reverse occurs, still it is certain that when irritating mental elements are eliminated, the best possible condition of mental rest is produced, and the natural recuperative forces have the best conditions to act. Compare if you will the opposite condition. Suppose the injured individual has a large family. Upon the receipt of his injury he knows that his means of supply are stopped; he sees prospectively before him a long siege of suffering and permanent disability, with no hope of bettering his condition, and the suffering of his family incidental thereto. Here at once we have created debilitating and disheartening influences inducing a morbid tone almost from the beginning. How the establishment of hope, assurance, and placidity of mind, and the withdrawal of a great deal of irritating circumstances, can make an individual "tend from the first day of illness to give a tone to his feelings and to affect his own impressions of the sufferings which he may have to undergo," giving him a less hopeful view of the future, and making him despondent about the prospects of his recovery, is certainly not clear, nor do we believe it; for our own experience indicates just the reverse. If compensation brings with it many elements of mental comfort, certain it is that the mind has been healthfully stimulated and soothed; and its response will be a manifestation of a more rapid return to convalescence than where the opposite condition exists.

There *seem* to arise incidental to the infliction of a railway injury many abnormal conditions, which are not to be found outside of railway injuries, while those inflicted by other agencies are at times essentially the same; but guided by the experience we have had, we do not believe that the qualifying term "railway" can and does subvert the eternal order of things. Compensation might, as we before said, be incidentally hurtful to some, but it is not natural to have it act so. To the young, to the practical, common-sense man, to the active man, to the man accustomed to outside life, to the railway man accustomed to open air and constant change, the narrow confines of a hospital life and the cramped conditions of medical treatment certainly will not possess many elements of pleasure. Compensation cannot in a brief time change the entire mental organization of man. The cupidity of some men undoubtedly makes them attempt to unduly lengthen out and exaggerate their condition; but if this is met by intelligent medical treatment its results are easily overcome. Viewed by one who has studied its effects under all of its varied aspects, compensation cannot appear in any other light than beneficial. We cannot see how it possibly produces effects other than as indicated. Of course, we can readily see that if these individuals should get sufficient compensation to assure them of opulence in the future, the result might be that described by Page; but in every-day life, where compensation is given upon a basis of justice, its effects certainly are beneficial.

We have often thought that had Erichsen, in his graphic and classical work "On Railway and Other Injuries of the Nervous System," confined himself to clinical description, his work would have stood in the light which its merits deserve. But when he gave the details of the monetary consideration received in each case, he aroused the cupidity of the world, and detracted from the pure scientific character of his exposition. The damages awarded were enormous, and before undreamed of. We read: "The question of damages resolved itself to a great extent into one of loss of income and expense incurred. The jury awarded

£5,775;" or "the plaintiff recovered £6,000."[1] In this country, owing to the example quoted, damages have been awarded in this class of cases as high as $49,000. From this on, railway spine and railway brain became speculative troubles. Not a physician read who was not impressed; dishonest ones not only supplied the legal side of the question with its medical data, but invariably pointed to the financial side. No medical book ever written has been more extensively read by the laity; and none certainly has ever been more closely studied. It has been the means, by its plain, graphic description, of educating more malingerers than any single book emanating from a professional mind. It has been the foundation of "compensation." If the "baneful effects of compensation" lead to the production of marked psychic anomalies, the story of the awards of damages, first detailed by Erichsen, first plainly emphasized this factor, and make it a disease-producing element. In describing a new trouble Erichsen made operative a new influence, which, in its turn, is oftentimes more serious in its effects upon the psychic condition of injured persons than traumatism itself.

MALINGERING—A GENERAL CONSIDERATION.

Robert Farquharson says: "While proceeding in the examination of a case of supposed malingering, due caution should be observed. The practitioner must endeavor to hold the balance between an excess of suspicion and a too credulous attitude, remembering that the good of society and of the public service must be fairly considered; while all care must be taken not to confuse the innocent with those whose ingenuity has occasionally enabled them to feign. Again, the progress of science and approved methods of diagnosis have rendered the task of the impostor difficult, if not well-nigh hopeless. Feigned blindness can hardly resist the test of the ophthalmoscope. Electricity will clear up many apparently anomalous nervous symptoms. The stethoscope and the sphygmograph will tell us the real condition of the heart; and careful observation will detect rougher attempts to deceive. Again malingering may often be exposed by examination under chloroform or ether. We are not likely now to be taken in by a piece of liver tied to the breast to simulate a cancer, or by an artificial nasal polypus; and although diseases and ulcerations may be kept up by local applications, we only require a suspicion to cross our minds to put us on the right track for discovery."

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[1] Erichsen, *loc. cit.*

Dr. Farquharson's directions are thus freely quoted, because for a number of years they have been our guide; and they have been the means of enabling the writer to expose a great number of malingerers. We should much rather have a thoroughly competent, guileless, and unsuspicious physician or surgeon examine a case wherein elements of malingering were manifest, than a prejudiced, suspicious, and biased physician. If the true lines of diagnosis are adhered to, the malingerer will be completely thrown off of his guard by the absolute manifestation of honesty upon the part of the examiner. The malingerer will almost unwittingly expose himself in some exaggerated manner. But the physician who starts from the beginning with suspicion and prejudice, unless he is a marvellous and unusual character, will show almost unconsciously the prejudice that is in him, and just in proportion as he makes this manifest will the malingerer protectively defend himself. It is not a mistaken assertion to make, that honesty when facing dishonesty is, as a rule, competent to confuse the latter; naturally and obviously because the malingerer's methods are all predicated upon dishonesty, and it simply confuses his line of thought, when his assertions are taken as true and proven to his face as false.

We do not propose to enter into an extended dissertation regarding the general moral character of the malingerer, except to say that he is frequently of a low moral tone and usually incompetent mentally to appreciate the best elements of study or thought. Again this desire to cheat or defraud in many cases has been inherited, or rendered acute by some predisposing or acquired disease. Many cases constantly come under the observation of the physician where deception is the result of pathological conditions; such patients are pathological liars, and they should not be held as gravely responsible, since the condition is the result of a disease. This deception is at times involuntarily made in consequence of some diseased nervous impulse. Again, there are persons who have inherited immoral elements of character; such persons lie naturally, because they have honestly inherited it from their progenitors. They are physiological liars; it is as natural for them to lie as it is for them to breathe.

The malingerer who, in consequence of a lowered moral tone, deliberately sets himself to work, in well-considered and deliberate order, to make or establish his deceit, is generally a malingerer who is to be the least feared of all sorts and kinds of malingerers; because, as a rule, his dishonesty is rarely competent to defeat honesty. After many years of experience in this kind of work, we are thankful for the fact that very few malingerers successfully deceived us; but with exaggeration of symptoms, our experience has been the reverse. In one portion of this work we have already referred to the influences that are injurious to a true case of traumatic neurosis; namely, specialistic examinations which seem to increase and intensify an already existing neurotic condition; but for the detection of the true malingerer nothing has equalled specialistic examinations; for they debar the possibility of the assertion being made, as when only one examiner is used, that the examiners have been prejudiced.

To better show this point let us give an illustration. An individual was blown up by the explosion of a steam dome, as he claimed, some fifteen feet in the air. He sustained a contused and lacerated wound at the middle portion of the supra-orbital ridge, wherein the supra-orbital nerve was plainly injured. He received diverse contusions about his head and back, and claimed that his perineum had been so injured as to cause stricture of the urethra, necessitating the employment of a catheter for some time. In addition thereto, he received scalds on the inner side of right thigh. After an enforced rest for two months, he claimed that he had partially lost his hearing on one side, and completely on the other; also, that his eyesight was so interfered with that he was incompetent to read, and at times became almost blind. He complained of a difficulty in breathing, and that an excessive palpitation of the heart at times incapacitated him. At the same time, he claimed an utter inability to void his urine as he was wont to do.

With an honest desire that this man should not suffer in consequence of a prejudiced idea which we had gained in consequence of the physical appearance of the individual, he was sent to specialists. His countenance was clear, ruddy, and healthy; his eyes, particularly the conjunctiva, looked healthful, bright, and brilliant; there was no emaciation about the face or body; there was a brisk, energetic and business-like air about his movements; no signs of paralysis, except slight ptosis of right upper lid, owing to injury of the supra-orbital nerve on that side. The urethra was examined and stricture disproved at once. The heart and lungs were found healthy. The throat, heart, and lungs were examined by specialists, and a normal condition reported. The oculist made several examinations of his eyes, and reported the fact that the patient under consideration had no diseased condition present. The aurist, upon the fourth examination, showed to a number of people sitting in his office, and present during the examination, the utter falsity of the claim of deafness, to the patient's confusion.

This individual afterward declared that in his ignorance he had tried to make up this condition, but he was free to confess that had he known what he had to undergo he never would have attempted it.

SPECIAL CHARACTERISTICS OF MALINGERING AND EXAGGERATION.

It can be stated as a matter of fact that the simulator of traumatic neurosis will encounter continuous and positive trouble under scientific supervision; and we doubt the possibility of his succeeding, unless he shall have unusual knowledge at command. The greatest element of difficulty in the examination of these cases is to determine the degree of exaggeration, which at times it seems almost impossible to accomplish. If the time is limited in which an expert is compelled to work to make examinations into this trouble, the difficulty is proportionally enhanced. Right here is where many of the profession fail to place themselves in proper position. They will, without thought, at once accept these cases for examination, when the time afforded them is so short as certainly to debar the possibility of thoroughness. It would appear that common-sense practitioners should refuse to take the examination of a case until they had received permission to use what they conceive to be necessary time. It is by imperfect methods that truth is not reached; it is by imperfect examinations that the simulator accomplishes his ends; it is by these methods that expert testimony becomes a farce, instead of a potent factor in the detection of malingering. It should be remembered that in traumatic neurosis there are often hysterical symptoms, and a patient whose general reliability may not be questioned under ordinary circumstances, as stated by Page and others, in this condition is frequently the victim of his own deception; and that more than other people. This strange disease, to one not well versed in the study of its transitional stages, seems to constantly present elements of pretence. We are free to confess that one of the most difficult and seemingly impossible tasks to accomplish is to draw a dividing line between an hysterical patient's actual condition and the exaggeration. Its strangely irregular forms present scarcely a symptom that is not thoroughly and intensely exaggerated. Thus, we have not infrequently noted that a suggestion given by any one in the patient's presence, of having the semblance of some symptom, is immediately assumed. If the physician but remotely suggests any idea leading up to a symptom not already possessed, it is only a short time when this symptom will be strongly manifest. There appears to exist in the patients an acuity of intellect which is almost as marvellous as the receptive element of the brain. It would seem as though the patient's mind was intent upon the purpose of mimicking anything and everything pertaining to his diseased condition. A case in point will not be out of place. We believe this individual was as much a combina- of an injured man and a fraud as could well be devised.

The history of the case is as follows: The man, while on top of a car in motion, fell off the same backward, striking his back against another car some six feet below him, and from this to the ground below, where his head struck a tie. He was rendered unconscious at once and did not return to consciousness for nearly an hour. He was brought to the hospital some eight hours afterward. There were no external evidences of excessive shock, as manifested in cold, clammy, and contracted skin; the pupils of eyes were found dilated. The pulse showed shock, and was rapid and weak—130 per minute. He claimed to have voided his urine naturally after the accident, but after becoming conscious he averred that he could not move his legs, and that they were numb and tingling. Examination revealed obtunded sensation in irregular areas above anterior superior spinous processes of the ilium and down to the toes. There was no evidence of an external injury to the back. He spoke in a stammering manner.

Skin warm; no indication of moisture; retention of the urine, which continued until the fifth day. Twelve days after the accident there was sensation on the outer side of legs. He manifested thereafter more or less marked symptoms of an hysterical condition. On the forty-eighth day after his injury he became aphonic and complained that his eyes had become defective. Eighty-six days after his injury a peculiar symptom became manifest, which he stated he found out by accident. He stated that by pressing on a certain sore spot at the back of the head, about in the median line on the level of occipital attachment of the occipito-frontalis muscle, he would become totally blind. The aphonia continued along with more or less variation of defective vision, and at times he had hystero-epileptiform convulsions. The man was able to go about the ward while in a wheeled-chair after the third week of his injury, and continued to until the date of his discharge. An examination of his eyes was made by Prof. A. Alt, which is reported as follows: "I examined the man for the first time on March 22d. He stated to me that his right eye was totally blind, and his left one too poor to read with. He also stated that he could render this, his better eye, totally blind by pressure on his occiput. The following was what I found: outer aspect of both eyes normal; motility normal, pupils medium wide, reacting equally well to light and accommodation. Right optic nerve somewhat reddish, but outline sharp; arteries of retina thin, veins slightly tortuous but not then hyperæmic. Left optic nerve also slightly reddish, retinal veins somewhat tortuous. I then examined the spot which, when pressed upon, would render him blind. He gave it as lying to the left and a little below the protuberantia occipitalis, and when I palpated it, he stated that 'the whole neighborhood' there would do. In palpating the region I could neither find the evidence of a fracture nor a thin and perhaps elastic portion of the bone; and although I pressed hard, he did not get blind. I then had the spot indicated by him pressed upon while looking into his good eye—that is, the left—with the ophthalmoscope. No change in the filling of the blood-vessels occurred, but he promptly stated that he was now totally blind. Upon being asked how long this blindness usually lasted he said for about an hour. In spite of that he counted fingers at three feet correctly afterward, and wheeled himself back into the ward through a narrow and crooked passage with the greatest security. About five minutes later I let him count my fingers again. He now counted them at six feet, but kept his gaze steadily on them for a much greater distance, although he stated he could not see them. The state of his optic nerves not explaining his blindness satisfactorily, and having heard of examinations that had been previously made, I saw him again two days later. On being asked how he could see that day he said, 'Oh, very well to-day.' Upon making him count my fingers, he refused to see them any further than six feet from him, although again he kept his gaze steadily on them for a much greater distance. I then told him I had brought some glasses along which I was confident would make him see better. Placing my assistant six feet from him I let him count the fingers, which he did readily. While he did so I placed a prism of twelve base downward before his good—left—eye, when he said immediately, 'Now everything is mixed up.' I then asked him, 'Do you see one or two hands?' and he unhesitatingly stated, 'Two.' Of course if all of the facts here reported were not sufficient to arouse the suspicion of malingering, the prism test proved beyond a doubt that, with regard to the statements he made about his one-sided blindness, he was a liar."

There never had been any sign of motion of his paraplegic inferior extremities; besides, the parts from knee downward were cold, œdematous, and cyanosed. This patient received an amount of compensation which we were certain was insufficient to produce marked reaction. Yet within seven hours after compensation had been paid him he was able to use his œdematous and cyanotic limbs somewhat freely. At no period from that time on was paralysis manifest. A letter was written to this individual some two months afterward, inquiring concerning his condition. We received very promptly an answer in which he averred that his voice had returned after sixteen bones of various sizes had come out of his throat. We tried to obtain one or more of these bones afterward, in another letter, and, of course, failed. But he stated that his eyes were still weak, and had not regained their full strength. In the daily examination of this patient while in hospital, and the examinations made by four other *confrères*, the conclusion reached was, that the case was not one of pure malingering, but one of extreme exaggeration of symptoms, backed by hysterical elements. We cannot conceive how any mortal could have imitated and gone through with the various phases of suffering he manifested, unless there had been some morbid condition at the back.

SO-CALLED DETECTIVE METHODS OF DETERMINING MALINGERING.

In the examination of these cases it has seemed to us that the use of detective methods is seldom demanded. Such a method is the acceptance of assertions of outsiders who would claim, for instance, to have seen a paralytic walk, or who describe what they conceive to be the patient's condition. While this at times may appear to accomplish the purpose, yet we conceive it to be working upon an unscientific principle. We admit that in the attempt to discover malingering we are justified in proving the truth or falsity of symptoms in almost any convincing manner, but it has often occurred to us in our examination of these cases, that, if our knowledge and capacity were not sufficient to determine them, the various detective methods certainly would not.

It is a good deal like using indiscriminately and injudiciously anæsthetics in the investigation of these conditions. Thus, for instance, Guillemand says: "The question of using anæsthetics, having been advocated for a brief time, has been likewise rejected. Their employment is no doubt a little dangerous; and be the danger ever so small, we have no right to subject the patient to it. It was proposed to utilize the period of excitement preceding anæsthesia, or that following it, which is characterized by unconscious loquacity, in the hope that thus certain facts testifying to the fraud employed by the subject might be revealed. This means, aside from the possible danger it involves, is as unworthy of medical science as that which consists in obtaining a confession by the aid of intoxicants."[1]

We are free to confess that the use of anæsthetics, predicated upon the fact of obtaining warped and intoxicated utterance, is poor sense. But it is nevertheless true that such methods are justifiable in proportion to the dishonorable methods used by the malingerer. Where the physician has obtained a clear, explicit history of a case; where he has been placed in a position to know exactly the degree of force that produced injury; and where a patient clearly has the purpose to deceive, a resort to such means may be warranted.

Thus, for example, a man fell off a car, but, as stated by those who saw him, he did not fall sufficiently hard to hurt any one. He immediately became paralyzed, and was brought to the hospital. There were no evidences of injury present. The skin was of a healthy hue, eyes bright, and cutaneous surface warm. He was uncertain as regards every element of sensation. He had retention of urine, which was the only clear symptom present, and which we believe was feigned. He remained in this condition of paralysis for twenty-four hours, but laughed and joked with those around him. This patient was put upon the operating table, and ether was administered. During the anæsthesia it required two men to hold his legs on the table. As he gradually came from under the influence of the anæsthetic, his limbs were slapped, and in inelegant language he insisted upon being let alone. Then his limbs were gradually placed in a position for locomotion and he was made to walk. From that day on he never evinced any symptom of paralysis.

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[1] Lauenstein has lately advocated chloroform narcosis as a means of unmasking simulated traumatic neuroses, and cites a case in illustration in which rigidity disappeared under the above test, causing him to conclude that the patient was a malingerer. Friedman contests Lauenstein's deductions and the value of chloroform narcosis. He cites the case of a man who had clonic splasm of the hands. These ceased during chloroform administration, but on recovery from the narcosis the movements returned. As a basis of his belief in favor of these rhythmic contractions originating in the brain cortex, independently of volition, he alleges that he produced suspension of athetoid movements in a paralytic by passing a constant current through the fronto-parietal regions.—J. A. Booth, M.D., *loc. cit.*

We have records of three cases of this kind, in which we were led to our conclusions by the physical conditions which presented themselves. One patient allowed that he had been "whipped" this time, but he had made a good "stake" before.

Again, we should not, under any circumstances, use an anæsthetic, unless our previous knowledge and close study of the case indicated to us that some rude shock was necessary to make a scheming mind realize that its lies were not believed.

We have never at any time used the subterfuge of visiting a patient unexpectedly, or returned immediately after making a visit, on the pretext that we had left something behind. Nor have we ever followed a patient, and, unbeknown to him, watched his walk and attitude. Beyond the use of an anæsthetic, we have never resorted to any means of torture to wrest from a patient a confession; if we were not able by an examination based upon purely scientific lines to accomplish our purpose, we never thought of other means. We can readily conceive that the proper use of a "Kodak" might give evidence of malingering; but still we think that the best manner to determine this condition is to follow a strictly scientific method of personal examination.

A CONSIDERATION OF PRECEDENT DISEASES, OR SO-CALLED SUBSTITUTION OF ORIGIN.

In the examination of cases of supposed malingering it is always pre-eminently proper for the examiner to take especial note, under the most favorable conditions of examination, regarding the appearances as they present themselves particularly upon the surface of the body. With honest and conscientious endeavor, it is never necessary to permit any prudery to interfere with an examination. The parts under examination should be freely exposed, but always gentlemanly and kindly consideration is demanded. If naked-eye lesions are manifest, we examine, compare, and obtain their history. In supposed joint troubles the regular rules of surgery are always sufficient to afford legitimate conclusions, the injured side being always compared with the normal side. It has been our privilege to put to confusion many assumptions of injury by following out the scientific line of examination. Thus, an injured passenger, claiming to have been hurt on a train which had become derailed, presented himself for examination, saying that the elbow-joint on his right side had been broken. Examination revealed an enlarged and diseased joint, giving all the evidences of chronic inflammation. He was accompanied by two lawyers and several friends. Upon comparison of the two sides it was shown to the satisfaction of all present that this person's injuries, if any existed, were not great; as he asserted, he had been subject to articular rheumatism. The two joints were in essentially the same condition, and not only this, but the knee-joints were shown to be involved likewise. While finding it impossible to prove that this injury had not intensified his rheumatic condition, he was settled with on the basis that probably his rheumatism had been increased, but not because there were any evidences of an injury having been inflicted. Owing to the fact of being placed in a favorable position for obtaining an immediate and correct history of these cases, it is rare indeed to have substitution of origin presented; certainly never with the employee, and only in those cases that are taken from observation. We have never been either confused by hernias, hydroceles, or orchitis. It has been our experience to meet with cases of uterine prolapse, but it has been easily and almost invariably shown by a precedent history that the assertions were false. Upon one occasion a woman in stepping off the platform of a passenger coach, which had started before she was fully off, claimed that in consequence of her accelerated motion a femoral hernia was produced. She was then in the eighth month of her pregnancy. A suit was entered for ten thousand dollars. After the birth of her child an ovarian tumor made itself manifest, and grew into large proportions. This, along with pregnancy, was

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Usually the attempt to palm off various precedent diseases is made by those but poorly versed in medicine; and in our experience they are easily frustrated.

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shown to be the more probable cause of hernial protrusion than the accident. The suit was withdrawn without compensation, after the history of the case was evolved.

It is asserted by various authorities that such conditions as atrophic paralysis of the muscles of the arm dating from infancy have been presented as results of railway injury; but the shortening of the bones of the arm easily establishes the nature of the precedent trouble.

The most delicate question to determine, in the examination of the cases where lesions are present, is the extent to which the trauma has intensified the already existing condition. Rheumatism in persons subject to it may be intensified by injury; still it is rarely difficult to prove that the trouble dates back of the injury. In how far pain and enforced rest has been occasioned by the injury, is problematical; although, when it can be proven that precedent disease existed, there is a contributing condition by which the legal liability is of course lessened.

Usually the attempt to palm off various precedent diseases is made by those but poorly versed in medicine; and in our experience they are easily frustrated.

CHAPTER V.

A GENERAL CONSIDERATION OF PROGNOSIS.—ENGLISH, AMERICAN, AND CONTINENTAL AUTHORS.

A General Consideration of Prognosis.

At one time or another in the treatment of cases of traumatic neurosis the question invariably arises whether the disease is curable, and if so, in what period of time? What will be the influence of this trouble as regards the future capacity of individual hurt? Will he be permanently disabled or not? Will his earning capacity be destroyed? Is he only partially disabled? What are the chances? These questions constitute at times some of the most difficult points in the determination of cases of this character. Thus far, in the general consideration of subjects incidental to traumatisms arising on railways, we have given prognoses under their respective heads; but now, in the consideration of traumatic neurosis, our work is only half done without taking into consideration the elements and general opinions of authorities regarding this trouble. There is no greater discrepancy of opinion by writers upon this subject than on the subject of prognoses. It would appear that varying conditions have constant and manifest influence, and there can be no reasonable doubt that compensation is a factor which produces a great deal of this discrepancy, and a confusion in the minds of honest physicians, arising from the fact that no honest practitioner would wilfully desire to injure any one suffering from a supposed incurable trouble. Such doubt naturally indicates caution; it is indicative of the very best purpose upon the part of the just and honest practitioner. Among the most important causes for this condition is the fact of the extremely limited time which the majority of our profession have for considering this trouble. The treatment used, as a rule, is inadequate and improper and cannot possibly give a chance for a good prognosis. Also in the examination of cases in expert work, the time used is utterly inadequate to accomplish the desired result. This is particularly so in this country. It would not be a rash assertion to say that not one case in twenty is examined under conditions favorable to its solution.

It has always been with us an unexplained point in the consideration of this trouble, why we have so great differences between various writers on this subject. The assertions of English authors on prognosis are almost at the opposite extreme from the opinions prevalent in France and Germany. The observers in these various countries are perfectly competent and honest, and there must be some other determining factor besides the influence of compensation, and that of surroundings and favorable circumstance. It has constantly occurred to us that probably racial differences might solve the problem. There certainly must be some hidden influence which makes the vast discrepancy as at present indicated between the authors in these different countries. The greater bulk of cases coming under our own observation have been among the employees of a railway. We make no apology for quoting from our experience in this direction, as we honestly believe that they more truly typify the injuries occurring upon railways than do those of the passengers, as the conditions which cause them are constantly acting in a more violent form than with the passengers. Admitting that familiarity with dangerous surroundings and physical conditions are constantly modifying factors, still the discrepancy is too great even to have these influences produce it. There certainly cannot be any doubt regarding the influence of favorable surroundings, nor will there be any question regarding the reverse. The thought naturally arises where good results have been obtained, that where different results follow some defect must have existed either of heredity, treatment, or surroundings. To one having experience in litigation wherein railways are concerned, any seemingly erratic and unjust action upon the part of an injured passenger of a railway is never a surprise; because one invariably sees so many evidences of rank injustice that it finally comes to be considered a normal consequence which surroundings have created. Fraud is constantly manifest; injustice is very frequent, which even innocent persons are led into in consequence of the full force of existing conditions, where unprincipled and scheming persons use the injured passenger as a means to accomplish selfish and unjust ends, aided and assisted at times by honest, truthful, and competent scientific authority. Hence there is naturally aroused in the minds of physicians who have been fortunate enough to see the full force of favorable conditions in the treatment of these cases, a sense of great inconsistency. The part most to be deplored is the fact that honest and competent physicians are so often led astray in consequence of certain restrictions placed upon them; namely, the inadequate time given for examinations and the contracted demands of law. Thus, a medical question has to be answered that has been formulated by a legal mind; where a theory made in law forces the honest physician to answer in a thoroughly cramped, concise, and legal manner. It would seem as if the law were made, particularly in these cases, to force honest medical authority within the restrictions of legal conditions.

The positive influence of proper surroundings, as shown in hospital work, where we have even the elements of compensation acting in their most effective way, and where surroundings are made to act in their most favorable manner, can be plainly shown. It has been the writer's privilege to attend in the past thirteen years from five hundred to two thousand injured railway employees annually, and yet during that entire time he has treated only six cases of traumatic neurosis; and in this number there is not a single case wherein cure was not the result. The injured employee, in settling with the company, always settles upon a basis of re-employment, and generally continues in the service of the company; and if cure was not the result, certain it is a return to the hospital would be almost invariable. It is true that in some cases the treatment has been of long duration—in one case nearly eleven months; in another over five months, in another over four months; but generally much less time accomplishes the result. We have stated before that, according to the information which we have gained, in 18,885 employees injured, but eight cases of traumatic neuroses occurred, or one in 2,360⅝. As a rule, these persons were injured under conditions more intense, forcible, and harrowing than those affecting the passenger. But we find that about one in every sixty-five passengers had this trouble.

We have a complete history of but five of these cases occurring to passengers, and only one at the present time seems to have any effects remaining. The other eight cases of passengers we have no record of, and therefore can draw no conclusions concerning them. The difference is so enormous between the relative frequency of this trouble among injured employees and among injured passengers, that we cannot fully explain it. The writer does not propose to place his dictum against quoted authors, but has earnestly tried to give a truthful detail of his experience in connection with this trouble. It may be possible that our experience is thoroughly exceptional. We acknowledge the fact of our utter confusion in the wide differences given in consideration of prognosis in traumatic neurosis by the most competent opinions upon this subject. Compensation is generally considered by authors as not only baneful, but as an absolutely aiding and developing factor in delaying cure. Compensation (when not extravagant), as viewed by the writer, does not possess the incidental elements of worry and harassment that obtain when litigation is indulged in. There has not been a single case among employees where compensation has not been a consideration from the beginning. It is true that this element of compensation has not been in its most extravagant form, but it has always been a constant consideration, and has rested upon compromise and not litigation. We are free to confess that in our view the influence of compromise is great. It relieves the injured individual of all the attendant worries incidental to litigation; its influence is in the direction of mild, normal, and unruffled action. For many years we have always considered this in the treatment of our cases, indicating to the patient that if he would settle with the company the effect would be beneficial for him. It will be found that when compromise is viewed in all of its lights, its influence is invariably good; thus tension is avoided, and there are no aggravating states of suspense. Under such circumstances we look upon the prognosis as favorable.

THORBURN'S VIEWS OF PROGNOSIS.[1]

We find, after leaving out the element of compensation with the employee, that Thorburn's ideas verify our own. He says,

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[1] *Loc. cit.*

"If, then, there be no pecuniary complications, and if the case be at once placed under proper treatment, we may apparently expect perfect recovery within a few weeks. If, again, the case be neglected, but the finançial difficulty be still excluded, the symptoms appear to become more fixed, and a longer period, probably some months, may be required for an absolute cure. That in either case an absolute cure is to be expected appears to me almost certain, both from the above-quoted and other published cases. I am confirmed in this opinion by the fact that, whereas traumatic hysteria is by no means rare, I am unacquainted with any standing incurable cases, such as we should meet if the symptoms were persistent; and at the same time—as is universally admitted—it is very rarely fatal. Unfortunately the majority of these cases arise from railway injuries, and here we always have the baneful effects of the compensation question. Now it must be admitted that these cases do not recover as rapidly as those to which we have already referred; and we are led to ask why this should be so. Is it because the results of railway collisions are much more severe, or because the expectation of compensation increases the duration of the symptoms? Connected as I have been with two railway companies, I have been struck with two facts, viz.: First, that among the large number of railway officials of every source or grade whom I have known, many of whom have been passengers at the time of collisions, and none of whom could claim compensation, I have never met with any who have suffered from severe or persistent nervous symptoms. And second, that in none of the accidents with which I have been concerned has any railway servant complained of such symptoms. Bruises, fractures, burns, and deaths, we meet with only too frequently, but traumatic hysteria is to me unknown in either of these two classes of persons. As railway officials are constituted like the rest of the population, I presume that they do occasionally suffer from traumatic hysteria, and I can therefore only conclude that they recover from it within a very brief period. We are thus driven to the view that compensation, or, rather, waiting for compensation, markedly aggravates the hysterical symptoms, a position which we can assume without for one moment impugning the honesty of all the sufferers with whom we meet. The origin of traumatic hysteria being an idea or a suggestion, it is but natural that anything which tends to fix this idea will operate toward retarding convalescence. In a compensation case everything does tend to fix the idea. The repeated examinations by various experts, the frequency with which the patient is called upon to detail his every symptom and sensation, the account of his accident which he reads in the press, the almost continuous repetition to himself of his sufferings, all serve but too well to rivet the suggestion on a mind weakened by the worry of legal proceedings and by the fear of the popularly accepted fate of the victim of railway spine. And thus we find that in these 'compensation cases' the prognosis of traumatic hysteria becomes much more grave than in those to which we have referred. In order to give the more accurate prognosis it is necessary to consider certain other conditions which will influence the duration of traumatic hysteria. Thus in the male the symptoms, although less readily produced, appear to be more fixed in character than in the female (Charcot). A neurotic tendency, whether hereditary or acquired, is also of bad omen. Chronic alcoholism again tends to render the prognosis worse. Marked variation in the symptoms, such as transference of hemianæsthesia from one side of the body to the other, or its temporary disappearance, are eminently favorable conditions. In the above remarks, the rare eventuality of death has been ignored. Life is but seldom imperilled by traumatic hysteria, but complications may ensue—which terminate in death."

DR. BYROM BRAMWELL'S IDEAS OF PROGNOSIS.[1]

Again, let us quote the ideas of Dr. Byrom Bramwell concerning prognosis in traumatic neurosis. He avers that the future progress and course in cases of this kind are in fact variable. In almost all cases the symptoms persisted and became worse rather than better so long as the anxiety and worry attending litigation were hanging over the head of the patient. This was of course naturally to be expected. After the case was settled some patients got quickly well, but in others recovery was slow. In the great majority of cases recovery, however, ultimately took place. This was more particularly the case where the patient was young and strong. In old, weakly, and debilitated subjects, in those persons who had little or no reserve of nervous energy, the severe shock—to speak popularly—which the nervous system had received, and the prolonged suffering which the patients had gone through, might have so shattered their nerve tone that they never completely regained their former strength and activity. Even in these, the most unpromising cases, a very considerable improvement usually did take place. In judging of the probability of recovery in each particular case, the personal equation had to be taken into account. It was impossible to lay down any general rule which would apply to all cases, as each case had to be judged on its own individual merits.

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[1] London Lancet, *loc. cit.*

PAGE'S VIEWS ON PROGNOSIS IN TRAUMATIC NEUROSIS.

We shall not at this juncture apologize for freely quoting Page on this subject, as his views, while well known to all who have studied the subject under consideration, serve to accentuate what has been previously said.

"It remains to be considered to what extent recovery is possible in these cases of nervous shock, and how far the patient regains the mental and bodily vigor which he had before the accident. Happily the record of cases known to me is conclusive upon this point. Recovery is usually complete, and the patient is able to resume his occupation, and to carry on his business as well as he did before. There are, of course, exceptions to the rule, exceptions which show that some alteration has taken place in the bodily physique, and very possibly in the mental vigor also. Thus, you may hear that a man is less likely to bear prolonged fatigue either bodily or mental; that he is more susceptible to the influence of alcohol, more irritable and easily excited; that he lacks that complete self-control which he may formerly have had in his business relations with his fellow-man; that he is nervous when travelling, is afraid to ride or drive, and has been compelled to give up his hunting and shooting; that he is a more nervous man than he was before, and more subject to headaches; and in the severer cases that his hair has turned gray, and he looks prematurely aged. Some years have been added to his life, and he is never quite what he was before. And here very appropriately arises this important question, How far does the course of the protracted illness, apart from the nature of the original injury and shock, conduce to imperfect recovery hereafter? Remember that the symptoms have been largely those of an emotional disturbance; that the loss of control and feebleness of will have been at the foundation of many of them, and there can be no little doubt that an unconscious or wilful yielding to every sensation that may arise; the abandonment of conscious self to the thraldom of the morbid state; the enjoyment, so to speak, of the luxury, not a woe exactly, of gloomy forebodings and feelings and fears, pave the way for the impossibility of regaining, even in the best of circumstances, that complete mental stability and continuous self-control which are the happy appendage of perfect bodily and mental health. A vicious habit is being impressed upon his nervous system, from which the sufferer will find it difficult to rid himself. If he thus allows the various influences conducive to the morbid state to have mastery over him for weeks and months, because he thinks it better to 'wait and see how things turn out,' unable or making no determined effort to resume his natural occupation and mode of living until some wholly impossible compensation has been received, depend upon it he will suffer in the future. Or, worse than this, if he keeps up the morbid state by wilful means, his moral and his physical nature are subjected to a long spread-out shock from which it will be hard to rally. 'As he sows so shall he reap.'"

LANDON CARTER GRAY'S VIEWS OF PROGNOSIS.[1]

Landon Carter Gray says: "There has been much difference of opinion in regard to this very question of prognosis, but I think this difference has arisen mainly from the fact that sufficient regard has not been paid to the peculiar conditions in which patients of this class are usually placed. Few observers will deny, I think, that the symptoms of traumatic neurosis (neurasthenia), especially those due to railway accidents, almost invariably continue for a long time, disabling patients for many years, and in some cases even terminating fatally; but some of the very observers contend that the maintenance of the symptom is due to the psychical condition of the patient, while others insist that it is inherent to the disease. Certain it is that the psychical condition of these patients is a very unfortunate one. However uneducated they may be, newspapers and the talk of every-day life have filled their minds with dread of the mysterious and baleful consequences that may happen to those who receive injuries, particularly in railway accidents. They have also heard for years of the damages, often enormous, which corporations have been obliged to pay. When the accident occurs the nervous system undoubtedly receives a shock, perhaps intensified by the sight of the killed and wounded, with all the attendant horrors, and this shock should receive immediate and judicious treatment by rest, isolation, and medicaments. But instead of this a lawyer or his agent—the so-called 'runner' of this country—quickly appears upon the scene and spurs the patient on to a suit for damages by exaggerating the injury and its consequences, so as to make the too-willing sufferer believe that the company can be readily forced to pay damages. Then come the long years of weary suffering, anxiety, waiting, and disappointment, unrelieved by proper treatment; for, although the patient and the lawyer may not consciously discourage treatment, yet too many hopes and interests would be blasted by a cure to ever permit of treatment being properly carried on, even if any self-respecting physician could be found to undertake it. Months, perhaps a year or more, are passing in waiting for the suit to be tried. I have known of three years having elapsed before this was done, because of delay in obtaining evidence; then in fixing the responsibility upon the right corporation; then by alleged corruption of the attorneys; and finally by the long waiting before the case could be reached upon the calendar of the court. When the suit has been brought and pushed to successful termination, an appeal to a higher court will usually be taken, perhaps to a second higher court, and thus months or years more pass by. In some cases it may even happen that a successful issue in court of highest resort is contested upon a charge of conspiracy, or some matter of legal technicality that is concocted in order to gain time. Finally, the case being at last successfully ended, it may turn out, much more frequently than is dreamed of by those who have not had a long experience, that the costs of the action and the lawyers' fees will leave but a pitiful sum of money at the disposal of the patient.

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[1] *Loc. cit.*

"This is not an exaggerated picture by any means; it is a composite portrait of dozens of cases whose details can be taken from my case-books. All this disturbance that follows the accident is oftentimes, I am firmly convinced, a more potent cause of the neurasthenia than the accident itself; and I feel sure that it is the secondary psychical disturbance that makes this form of neurasthenia more intractable than other forms of neurasthenia; although I cannot quite agree with the statement which I have often heard made on the witness-stand by very competent colleagues, that traumatic neurasthenia does not differ from other forms of neurasthenia except in the psychical element. Notwithstanding that Charcot does not exactly say this, it is yet evident that he takes very much the same view in regard to the hysterical origin of these cases. Not only, however, are their symptoms to a certain extent pathognomonic, but there never yet has been any clinical proof adduced to demonstrate that the differences between this and other neurasthenic types is due alone to the mental elements. Nevertheless I firmly believe that it is the psychical element together with the resulting lack of proper treatment that makes the usual unfavorable prognosis of this class of cases.

"In several instances I have persuaded patients to promptly place themselves under treatment, and at the same time either to abandon or compromise the legal proceedings; and in every instance a cure has been effected. I have a history of fifteen such cases. In other words, in order to make my meaning perfectly plain, in a matter of this importance, let me repeat by stating that while I do not believe that traumatic neurasthenia is a species of disease that has distinctive features of its own, I do not believe that it has an unfavorable prognosis, provided that the psychical element can be excluded and prompt and proper treatment can be undertaken. It must be clearly borne in mind, however, that this statement applies only to this group of functional symptoms, and that it does not apply to organic diseases caused by injury. But moral responsibility cannot be hereby avoided by the persons or corporations by whom the injury has been caused; for whether the neurasthenia is rendered more intractable or not by the accompanying psychical element, the injury itself has been the cause of all the symptoms. Whether the legal responsibility of these individuals or corporations is lessened on this account, is a question of law for the courts to determine, and we physicians have nothing whatever to do with that aspect of the question."

Dercum's and Dana's Views of Prognosis.[1]

Dercum says: "My experience does not accord with that of those who claim that the symptoms in a given case disappear with the award of damages. That buoyancy and exaltation sometimes follow a successful issue of the trial, and that these symptoms of mental depression, so frequently present, disappear for a time, at least, cannot be denied. However, if the case be watched it will be found that long after the trial with its excitement has passed away, the ordinary symptoms of the case persist."

Dana, referring to Page, says: "His views are rather too hopeful, and decidedly are not always borne out by his own notes. 'Patient improving at last accounts,' is a formula given, but it may mean very little after all. Traumatic neurasthenia, or railway hysteria, is generally recovered from in a great measure. In my experience traumatic neurasthenia is the most amenable to treatment. But it is very often the case that the man who has had a severe nervous shock is never entirely the same man he was before. This is particularly the case if he has reached middle life, or is of a neuropathic constitution. The very old and the very young seem to suffer less." His conclusions are that the prognosis of railway or traumatic neurasthenia and hysteria is very good so far as steady improvement is concerned, not so good as regards complete recovery.

Putnam's, Knapp's, and Bremer's Views of Prognosis.[2]

Putnam says: "The question often arises in court, Does the fact that the symptoms complained of have endured a long time previous to the trial, warrant the conclusion that they will pass away but slowly if at all? It is probable that this question may be answered in the negative, so far as the localized functional disorders are concerned. Such symptoms may last indefinitely, so long as the influences are unfavorable to a cure—

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[1] Dercum: Alienist and Neurologist, *loc. cit.* Dana: New York Medical Record, *loc. cit.*

[2] Putnam: Am. Jour. Neurology and Psychiatry, *loc. cit.* Knapp: Boston Med. and Sur. Jour., *loc. cit.* Bremer: Alienist and Neurologist, *loc. cit.*

such as the prospects of a trial—yet in the end pass away very rapidly. Perhaps this is less often true, however, of cases of the neurasthenic type."

Knapp says: "Prognosis of these conditions is grave. Improvement is not uncommon, but complete recovery is rare."

Bremer, in the consideration of this subject, says: "The excitement incident to litigation renders these cases progressively worse, and many a claimant would have fared much better in health and happiness had he settled at a reasonable figure, instead of undergoing the harassing wear and tear of a lawsuit. Not the most liberal reward will repay such a man for the often deep and lasting damage his brain has sustained from prolonged litigation. On the other hand it is often astonishing what amount of elasticity and recuperative power is exhibited by the successful claimant. Nowhere has the gold cure celebrated greater triumphs than in the field of traumatic neurosis, if administered by a benevolent jury. There dwells a familiar figure in the memory of those who frequently have to deal with these cases, of the neurotic cripple who has to be assisted to ascend the witness-stand and gives his testimony in a feeble and broken voice, an utter, pitiable wreck, physically and mental; and who a few weeks later is capable of carrying the weight of several thousand dollars in silver, the award of damages, without any apparent difficulty. Again cases are on record where successful litigants openly bragged, after having secured their booty, how they duped the doctors, judge, and jury."

Clevenger, in his book on "Spinal Concussion," says: "As to prognosis (in traumatic neurosis) it is apparent that every case will have to be considered by itself. From the revision of the entire subject, it is seen that the old classifications and description included and omitted too much. Heavy and light blows may either of them cause slight or grave symptoms, and in time either of these may end in recovery or death."

Continental Writers' Views of Prognosis.

We have thus far given the opinions of English and American authors, and it will be found there is a considerable degree of uniformity, particularly when due consideration is given to the positive influences of adverse conditions. Many of the apparent differences of prognosis expressed in these two countries can be reconciled, but the differences between these and the views of observers are too great to be explained upon any other basis than that of a racial difference.

Oppenheim says: "As regards life the prognosis is favorable, except when nervous heart disturbances proceed to organic affections. A danger to life exists in an inclination to suicide through mind derangement, but this is seldom realized. Complete recovery seldom takes place in our observation. Even Page admits this; for in most of his cases he notes a diseased irritability remaining which marks the person as a 'damaged man.' At all times these cases are liable to develop a severe and hallucinatory bewilderment or insanity—a transformation which we have several times had an opportunity to witness. Of dubious prognosis are cases in which epilepsy or dementia is included in the symptoms, as well as where decided cardiac troubles are present. Not uncommonly a special *régime* produces a betterment in some cases; but it is especially observable that those who are involved in legal proceedings are retarded in their recovery, and this is a complication to be considered. Often the interest in an expected verdict causes the patient not to desire recovery until his suit is decided. The patient thinks it is to his interest to exaggerate the subjective difficulties and to simulate. The law proceedings weigh heavily upon the individual, and affect him more because he is mentally altered. So we often see improvement in symptoms after a favorable issue. But in my experience the greater number have, after the termination of a legal quarrel, remained unchanged in their ailments by the event."

Singer[1] states that of twenty-nine cases, three were cured; seven were completely capable of work; eleven partly recovered; and the rest were not improved.

Eisenholz and Schultze do not regard the prognosis as uniformly as bad as do other authorities. Freund refrains from taking the same dismal view as many other authorities. Dubois of France believes that cure is rare.

Guillemand in the consideration of prognosis classifies his cases under seven headings: (commencing with the second) hysterical accidents, neurasthenic accidents, hystero-neurasthenic accidents, hystero-traumatic accidents, traumatic-neurasthenic accidents, hystero-neurasthenic-traumatic accidents. He states that of all the neurotic states to which traumatism gives rise, hystero-traumatism compromises health the least, but he avers that at times it presents a tenacity which is despairing. Though presenting complications consisting of contractures and paralysis of long duration, the disease may disappear as suddenly as it came. Traumatic neurasthenia and traumatic hystero-neurasthenia, while the life of the patient is not absolutely menaced, are very troublesome. The affection may remain stationary, or recede, but the patient will never return to this former soundness. This is especially the case following railway accident.

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[1] *Loc. cit.*

M. Vibert states that prognosis is bad. M. Bouveret says in general that life is not compromised, and its duration is not diminished on account of the neurosis itself. Yet some patients have ideas of suicide to which they finally succumb.

It will be seen from the authors thus far quoted that extreme differences are particularly marked; hence nothing that we can say will present the subject in a better light than what Gray has said regarding the differences between hysteria as seen in this country and as described by Charcot in France: "It is possible, however, that too little account has been taken of the inherent differences that there are between the Latin and the Anglo-Saxon races, and the race that is growing up in this country from a larger fusion of different nationalities than has ever taken place before in the recorded history of the world."

It is but natural to assume where we have multiblended inherited elements, that fixed types of disease are not likely to occur; certainly they are less likely to occur than where the opposite condition exists. We believe that the hysterical element is plainly natural to France; and we believe that the neurasthenic element is well pronounced and definite in Germany; but we are not as likely to find in this country any uniformity regarding the production of hysterical and neurasthenic conditions. Again we believe that too little account has been taken of the influence of just compromise. In this matter, accumulated experience will show that when all of the effects arising from the worry which is incidental to litigation are eliminated the prognosis is favorable; that unfavorable surroundings only confirm and intensify the original injury, and make prognosis unfavorable. It is constantly manifest that where rest, isolation, and the proper surroundings have been used, uniformly good results have been obtained. Hence if the full measure and force of compromise relieves all these elements of worry, waiting, and irritation, it certainly would seem that it should be used whenever and wherever possible. For many years we have seen the full force and beneficial element of compromise; and we cannot but think that in cases which assume a grave form, there has invariably been faulty treatment, environment, and circumstances to which the deplorable condition was more due than to the original injury.

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SIMULATED DISEASES.

BY

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THE RELATION OF SIMULATED DISEASES TO LEGAL MEDICINE.

THE difficulties of diagnosis which confront the medical man in his daily life are far more discouraging than most practitioners are willing to admit. To determine what is the matter with the patient requires oftentimes more skill than the decision as to means of cure. These difficulties are to be found most frequently in the irregular manifestation of disease. We do not find symptomatology either easy or satisfactory in a large proportion of cases.

Patients are frequently, like infants or animals, unable to tell us what is the matter. Experience is, after all, the great teacher, but observation is the great art so desirable in the successful doctor. While we have ignorance, fear, and prejudice to contend with more or less in every case which comes under our care, we have a large class of intentional deceivers who, actuated by shame, fear, or through dishonorable motives to arrive at personal and selfish ends, wilfully misrepresent. These are malingerers, and of these a very troublesome class are experts in their art. Some feigned diseases we discover are the offspring of morbid fancies or of positive mental disorder which we must in many cases recognize as demonstrations of actual insanity. To carefully sort out and scientifically classify all the cases which come under our observation, whether in hospital or private practice, is the difficult task which is ever new and ever urgent in the medical man's life.

Observation will be best trained by a thorough course in such hospitals as the Allgemeine Krankenhaus in Vienna, La Pitié and Charité and Hôtel Dieu in Paris, or the Royal Infirmary in Edinburgh, or St. Thomas in London—and I might also add in the admirable system of hospitals in our own land which have recently developed. In the wards of these large hospitals we pass and repass daily hundreds of patients whose facial expression alone gives instant information as to the whole medical history of the case. As the expert detects instantly the fraudulent bank-note by the faintest touch, so the practised physician sees by a glance at the countenance of the patient, the counterfeit of honest sickness or suffering.

We can, therefore, readily understand how important it is to be able to *diagnose* clearly the cases which are brought to our notice. The medical jurist must be able to expose the fraudulent symptoms. He must show clearly to the eyes of the law the methods of the impostor. On the other hand, he must be able to demonstrate just as clearly the true and just cause of a patient's seeking reasonable compensation for lasting bodily injury caused either by design or carelessness.

GENERAL RULES FOR DETECTION.

Our first inquiry should be as to the motive for the deception. Is it fear, shame, hope for gain, or love of notoriety? Or is it a manifestation of insanity? We frequently discover in women an uncontrollable desire to simulate disease. Hysteria very often manifests itself in feigned diseases. It is important to ascertain the habits as well as the surroundings of the suspected patient. The estimation of his character in the community in which he lives; the prevalence of epidemics of serious diseases; the existence of war, tumults, etc., all these have a powerful influence, through the desire to avoid danger of one form, to assume disease which would assure an avenue of escape.

Extraordinary as it may seem, the malingerer does not always seek to serve his best interests. Another element which we have noticed, and which enters largely into the investigation of simulated disease, is that of revenge or of hate. Guy mentions that there are several instances on record where persons have introduced poison into their own food and then feigned symptoms of being poisoned in order to bring a charge against persons whom they wished to injure; while Taylor observes that there are few of these accusers who go so far as to swallow poison under such circumstances. We have several times known of malingerers actually taking poison in order to more thoroughly give color to the deception.[1] Malingering is extensively carried on in this country for the purpose of extorting money from private individuals, corporations, cities, towns, etc.

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[1] "Simulated Opium Poisoning," N. Y. Medical Record, Feb. 21st, 1885.

The old-fashioned methods of deception are not so much in vogue. Modern methods are better adapted to deceive professional investigators. I have reported a case of pelvic cellulitis,[1] where a poor girl was supposed to be a malingerer. After securing a verdict in favor of the applicant the patient died from septicæmia.

It oftentimes requires repeated examinations to satisfy one's self as to diagnosis. I remember a case in my army experience where I reported a soldier as suffering from acute mania. My superior officer, a surgeon of large experience, discredited my diagnosis and entered the cell where the patient was confined. He was savagely assaulted and much injured. Within a few weeks the patient died with all the symptoms of acute mania.

It is necessary to meet the cunning and craftiness of this class of patients with dignified tact and composure, keeping steadily in view the detection of the motive. If possible see the patient when he does not see you; "compare the patient's relation of symptoms with known medical facts connected with the history of the real disorders. It is often useful to mention in the patient's hearing certain false symptoms of the alleged disease and afterward ask him after these symptoms; when, if simulating, he will be very apt to enact them, just as he heard them. Always suspect one who complains of a multitude of ailments and which have no natural connection with each other" (Reese).

In a case of feigned dumbness[2] I found the use of anæsthetics of the greatest value, thereby successfully demonstrating my diagnosis. In cases of feigned diseases in the hysterical the threat to employ harsh remedies such as the actual cautery, fly blister, etc., are often successful. But sometimes it seems as if nothing would be sufficient to counteract the persistent designs of the patient. Faithful observation and patience are our principal methods in the detection of simulated diseases.

Another class of troublesome impostors are the parents of children who have been vaccinated. A case occurred in my own practice where, after careful vaccination with the best virus obtainable, the patient suffered with severe inflammation of the arm. The child presented evidences of scrofulous taint. Some time after the vaccination it ate a quantity of unripe russet apples and died from convulsions. The parents claimed that the child died from the effects of the vaccination.

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[1] Medico-Legal Journal, June, 1888.

[2] "Feigned Dumbness," New York Medical Times, July, 1894.

The whole subject of simulated diseases would easily fill more than one large volume. All the ingenuity of the wise, the ignorant, the deceitful, or the coward can suggest are brought to bear in the working of this obnoxious art. And yet, as Dr. Hutchinson has so truthfully remarked, "it is far better to allow nineteen knaves a temporary success in their schemes than to refuse relief to one really urgent sufferer. Cases come very frequently under my notice in which great hardship would have been inflicted had the suspicion of malingering been hastily acted upon."

Many cases of malingering are simply diseases exaggerated. Such patients will often submit with eagerness to serious surgical interference. The danger of a hasty diagnosis should be well borne in mind. Every practitioner has been called to attend cases, dismissed as imaginative or malingering, which, upon more careful investigation, have proved to be serious illnesses.

Abortion.—It very seldom happens that any one would make an attempt to simulate such an unfortunate condition, but it is occasionally resorted to by blackmailers who hope thereby to obtain money from their victims. The symptoms simulated are those of great physical prostration with irritation of the external genitalia. The clothing and the person are usually stained with borrowed blood.[1]

A careful vaginal examination will detect the imposition.

Abstinence.—Within a comparatively few years public attention has been called to several cases of professional fasting. These have successfully avoided detection and created considerable notoriety, but what is of much greater importance to the fasters has been the accumulation of gain.

Generally speaking, the object in these cases is money, although we often meet with, in private practice, cases where young unmarried people pretend to exhibit profound grief by abstinence from food. The methods of detection are so obvious we need not consider them. With professional fasters the use of nutrient suppositories has been more than once suspected. (See STARVATION, Vol. I., pp. 820–822.)

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[1] New York Medico-Legal Journal, June, 1888.

Amputations.—We occasionally find malingerers assuming either loss of an arm or a leg as an excuse for begging. By careful wadding and the use of a canvas jacket, an arm is oftentimes successfully concealed. It is more difficult to assume amputation of the leg.

Factitious amputations are occasionally observed where malingerers have removed a finger or toe with a hatchet or a knife. Such extraordinary instances of self-mutilation are not absolutely uncommon.

While resident among many tribes of our North American Indians, I have seen instances of self-mutilation where the only gratification could be that of pride. The unsightly wounds and scars of the German student-duellists can be accounted for only by this theory. The self-mutilation of religious devotees extends back to the earliest times.

Aphonia.—I have already called attention to a case of hysterical aphonia reported in the July number of the *New York Medical Times.* In my experience this malingering is best exposed by the use of anæsthetics. This rarely fails.

Apoplexy.—Apoplexy is a disease seldom simulated by malingerers. From the nature of the disease it could not long be continued. It would be useful only where escape from immediate punishment was the object sought for. These impostors fall down suddenly as if deprived of consciousness. Detection is effected by the use of sternutatories, application of the electric battery, hot water, and even of the actual cautery.

Amaurotic Blindness.—Dr. Dunglison states that amaurotic blindness is simulated by applying the extract of belladonna or datura stramonium to the eye. Amaurosis is characterized by dilated pupil. (See EYE AND EAR, Vol. III.)

Anæmia.—The common simulation in most diseases is to make the face appear pale and the general condition weak and trembling. The physical examination for the detection of this imposition should be sought for in the character of the pulse, the action of the heart, and the condition of the skin. The tongue is frequently whitened with chalk, and excessive use of nicotine from an old pipe will produce the trembling condition.

Calculi, Excretion of.—One of the most extraordinary features in the study of malingering is that of the bogus excretion of calculi. This is invariably attempted by women, and in my opinion is merely a manifestation of hysteria gravis. Several prominent observers, Drs. Elliotson, Thompson, Ramsbottom, Golding Bird, all report cases where women have pretended to excrete calculi, which upon investigation have proved to be pebbles, sand, and other similar substances. Chemical analysis will of course readily arrive at detection.

Cancerous Ulcer.—Dr. Beck in his work on medical jurisprudence relates the case of a peasant woman who presented herself to one of the kings of France to be healed by his touch. This woman appeared to have a very large and ill-looking cancer of the breast, and it seemed so extremely natural that it might have deceived the spectators, but her apparent good health and absence of any cachexia caused suspicion of deceit.

She was examined, and it was found that a portion of spleen had been glued on its smooth side to the nipple, which left on the outside a serous and reddish kind of matter similar to that of cancer. When this was removed the nipple was found to be white, healthy, and well formed.

Ulcers are artificially produced by various juices and irritants, and real ones are kept open and prevented from healing by similar methods.

Copper coins are frequently placed upon or under the wound to cause violent inflammation.

Mr. Hutchinson amputated the leg of a man who persisted in cultivating a factitious ulcer. In several instances he used locked boxes so that patients could not irritate the sores.

Catalepsy.—This disease is unquestionably one of the commoner forms occurring in hysteria gravis. Cases of catalepsy occasionally are found in men. Dr. Dunglison states that the patient appears suddenly to be motionless, the joints remaining flexible, external objects making no impression. Detection is usually accomplished as recommended in the treatment of simulated apoplexy.

Opisthotonus is another common form of hysteria gravis, the patient bending the body backward, maintaining this attitude for some time.

The simulation of disease in hysterical patients covers the whole realm of medicine and is limited only by the imagination and perverseness of the patient.

In Beck's Jurisprudence a case is reported where the cataleptic cramps lasted three days, "during which the woman appeared insensible, took no food, and had no evacuation except a little urine by the catheter. The respiration was not perceptible, the pulse barely so upon careful examination. Her eyes were open and expressionless, the pupil contracted imperfectly, the eyelids remained immovable. The limbs when raised fell unresisting. The paroxysm arose from aversion to the attending physician. She desired the attendance of another physician, and the attack was terminated by his appearance." I have had under my care several similar cases, where the hysteria was accompanied by violent screaming, catalepsy, and in two instances ending with opisthotonus and general hysterical tetanus.

Consumption.—The simulation of this disease is quite a favorite one with malingerers. Emaciation is produced by abstinence. Coughing can be artificially produced or carried on without excitant. The bloody expectoration can be produced by picking the gums.

Detection can be arrived at by faithful physical investigation and by attentive examination of the symptoms.

Soldiers frequently attempt to simulate this disease in the hope of obtaining a discharge. They complain of pain in the chest. Patients recovering from catarrh and bronchitis frequently attempt to carry out this deception.

Contraction of Joints in General.—A trick familiar to those who have served in the army or navy is the simulated contraction of fingers, joints, etc. Very commonly the little finger is the one used in the practice of the deception. Active treatment, including irritants, the employment of the actual cautery, and the use of anæsthetics will very generally disclose the imposition.

A weight suspended from the contracted finger by a slender cord, and suddenly severed while the impostor's attention is momontarily attracted, will oftentimes disclose the fraud.

Cutaneous Diseases.—While a student in Professor Hardy's Clinic at the St. Louis Hospital in Paris, I witnessed a severe case of urticaria from indulgence in a quantity of strawberries. Some articles of diet will produce these disturbances in the cuticle, and the knowledge having been acquired by individuals is used for purposes of fraud. Simulation of skin diseases can also be produced by acids or irritants applied to the surface. Detection of these cases is often attended with great difficulty. They require special watching, and efforts should be made to cut off the supply which aids in the deception.

Deaf-Dumbness.—Those who are familiar with the unfortunates who suffer from this trouble will have noticed that such people have a peculiar expression, and that their general actions are such that they may be recognized from a distance. Impostors generally assume exaggerated symptoms. Anæsthetics will usually expose the deception.

Beck mentions many interesting cases, mostly soldiers attempting to obtain discharge.

A simple method for the detection of simulated dumbness is by the use of snuff, causing the suspect to sneeze.

Deafness is actually produced by the insertion of absorbent cotton moistened with glycerin into the ear. (See EYE AND EAR, Vol. III.)

Death.—Every student of physiology will remember the case of the officer who was able at will to arrest the action of the heart. Some people possess this power, and to excite pity or for other fraudulent reasons will pretend death. Methods recommend for the detection of apoplexy are available in this connection.

Debility.—We have already referred to the simulation of debility under the head of cachexia. While the malingerer will artificially whiten tongue and skin, and simulate a sickly condition which will oftentimes deceive the inexperienced; "the lustreless sunken eyes," the loose and flabby skin, the broad and watery tongue of extreme debility cannot well be imitated.

Paleness of the skin has been caused by inhaling the fumes of burning sulfur, the use of digitalis, the abuse of tobacco, purgatives, and emetics. Vinegar is frequently used to produce paleness.

Deformity.—The various methods employed in producing simulated deformity are very numerous. Ligatures placed around the thighs or the arm are sometimes made use of. Sometimes acrid plants are used.

Lateral curvatures of the spine, elevation of the shoulders, wry neck, contractions of the limbs or joints, intentional dislocations, ununited fractures, disease of the hip, all these deceptions are practised for the sake of obtaining money or commiseration.

The patient should be stripped naked, which will afford an opportunity to discover any pad or cushion used in the deception. Limbs should then be compared.

Delirium.—Delirium is sometimes assumed, but is mostly discovered in hysterical patients and is not a common form of deception. "Real delirium is accompanied by bodily disease with general wandering and incoherency" (Dunglison).

Delivery.—False pregnancy is oftentimes attempted for purposes of fraud, blackmail, etc. It can usually be readily detected by vaginal examination, the presence of a pad, and the absence of areola. Where pregnancy has been systematically simulated, and pretended delivery has taken place, the genitalia will be found moistened with borrowed blood and the child of another substituted.

This fraud can only be detected by careful local examination. The character of the lochia will require to be thoroughly investigated. (See FEIGNED PREGNANCY, Vol. II., pp. 334 *et seq.*)

Diarrhœa.—The commonest form of complaint among old soldiers, tramps, etc., is diarrhœa. The use of vinegar and burnt cork as well as a solution of sulfate of iron has been resorted to by this class of malingerers. Suppositories of soap and other irritating substances have been introduced into the rectum to imitate the mucous discharge of dysentery, and such persons find no difficulty in procuring the necessary blood to simulate dysentery.

The detection of this disease requires great watchfulness and very frequently a night nurse will be found useful. The linen should be carefully inspected. The genuine dysentery odor is of course absent in such cases (Dr. Coolidge).

Dropsy.—Dropsy is a rarer form of simulated disease. As in pregnancy, the use of pads and ligatures about the limbs to produce an anasarcous appearance are the means usually employed. Inflation of the cellular membrane of the abdomen is another method.

Epilepsy.—The professional impostors of England known as "tumblers," or "dummy chuckers," who simulate epilepsy, have frequently been successful in deceiving medical men. The condition appeals powerfully to the sympathies of onlookers. The foaming of the mouth after a sudden fall can be produced by soap, but the whole performance of the impostor has usually been obtained by long and patient practice. Searching inquiries should be made from some intelligent witness, as to the symptoms of the epileptic seizure.

Hysterical women frequently simulate epilepsy, having been impressed by witnessing the attacks of patients in public places.

The use of the actual cautery will very speedily expose impostors, a true epileptic being unmoved by pain.

The use of sternutatories is also recommended. (See Vol. III.)

Factitious and Fictitious Wounds.—The malingerer calls to his aid in his effort at imposture external agencies such as crutches, bandages, spectacles. But very frequently we find cases where self-inflicted or factitious wounds exist. These are oftentimes more difficult to diagnose than the pretended or fictitious injuries. Many of these malingerers are experts in their art and acquire most extraordinary ingenuity in carrying out their deceptions. Among soldiers and sailors this has been reduced to a science. But we find in every-day practice, even among children, the most deliberate and well-planned efforts at malingering. Soldiers frequently produce factitious wounds to secure discharge.

Another very common class of factitious wounds are inflicted by those who would pose as heroes in the prevention of the assassination of distinguished personages. Such cases remind one of those who pretend to rescue railway trains from disaster in the hope of obtaining a reward.

Among the objects sought for in the production of factitious wounds are the avoidance of military duty, relief from dangerous details, discharge from the service, relief from juror duty, and escape from punishment in general.

Fever.—Where fever is simulated the intermittent type is usually selected. In some cases fever is merely exaggerated, in others partly feigned and partly produced. Febrile symptoms may be excited by strong stimulants such as wine, brandy, and by the internal use of tobacco, which is generally known to act rapidly upon the heart action (Dr. Guy).

The tongue is whitened by pipe-clay, chalk, soap, flour, or whiting. It is tinged by brown brick-dust, licorice, gingerbread, and tobacco. Pallor of the skin can be imitated by the use of emetics, by smoking, by digitalis, or by drinking an infusion of cumin-seeds. The detection of cases of simulated fever is usually easy.

Generally speaking, such factitious fevers are ephemeral. Dr. Coolidge relates that feigned fevers usually are wanting in the appearance of a chill, impostors claiming that such a chill had taken place during the night.

Hæmatemesis.—Hæmatemesis is frequently simulated for purposes of fraud, or to excite pity, or to obtain excuse from military or other service. The impostors procure the blood of some animal or use some colored liquid, or by wounding the posterior nares sufficiently to swallow their own blood. This is vomited in the presence of spectators.

Some cases have been related where adults and even children have in this manner simulated hæmatemesis to successfully carry out the charge of ill treatment.

Hæmoptysis.—Hæmoptysis, like the foregoing, can be simulated by wounding the posterior nares or even the gums. The impostor simulates the disease by coughing and spitting up the blood. Careful physical examination for disease of the lungs will usually disclose fraudulent simulations.

Diseases of the Heart.—Simulation of diseases of the heart is less common among impostors, and means for its detection is readily available. The feebleness of the pulse, which has been produced by ligatures around the arm and by the use of internal remedies such as hellebore, is the most prominent symptom manufactured by the impostor. Dr. McClelland of Albany reported a case where a patient deceived the attending physician by placing his finger on the artery under the armpit whenever the pulse on the corresponding side was examined.

Reese relates that certain individuals can produce feebleness of the pulse by taking a deep inspiration and suspending the breathing.

Dr. Cheyne has reported the case of Colonel Townsend, where there was the voluntary suspension of the heart's action for a limited period. Digitalis, American hellebore, tobacco, and other drugs are capable of producing palpitation by internal or rectal use.

Palpitation may also be excited by strong compression of the abdomen with a bandage; in this manner hypertrophy may be induced.

Hæmorrhoids.—The skill of the impostor is shown by the ability with which he imitates the existence of piles. Like other hemorrhagic complaints such as menstruation, the staining of the clothing with borrowed blood is the principal effort made. Bladders of rats and small fish filled with blood have been introduced into the bowels. The diagnosis by a physician would naturally be simple enough. The means of detection is therefore very easily understood.

Hernia.—Cases of simulated hernia are exceedingly rare. One remarkable feature in feigned diseases is the skill by which these impostors are able to introduce air beneath the skin. In hernia, hydrocele, and hydrocephalus the deception depends upon the introduction of air.

Beck mentions that some men have the power of retaining the testis in the groin by the voluntary action of the cremaster muscles, and the swelling thus resulting has been mistaken for hernia.

Hysteria.—If hysterical demonstrations are extraordinary for their irregular and irrational motions when originating in patients, what must we expect when an impostor attempts the rôle? The probabilities are that the malingerer will overdo the attack.

Dr. Coolidge states that the severest forms of hysterical convulsion may be brought on by mere effort of the will, but when so induced cannot always be self-controlled. Such cases require the most attentive observation and frequently very harsh means for detection. (See Vol. III.)

Insanity.—Very much of what we have written concerning hysteria applies to the suspects of simulated insanity. The typical facial expression of the insane cannot be easily counterfeited. The feigned attack is shorter and less regular in its manifestations, the imitative actions are overdone.

Insanity is not commonly simulated. In the cases of murderers like Guiteau, Prendergast, and others the plea of insanity has been made in order to cheat the gallows. It would be impossible in a short article, such as this, to properly discuss the subject. (See Vol. III.)

Involuntary Stools.—If an examination of the sphincter-ani muscle is made and the contraction is found to be normal, we should suspect malingering in those cases where it is claimed that the passages are involuntary.

In children, the presence of intestinal worms often excites contractions, inducing emptying to the rectum. These movements have the nature of being involuntary. Such cases require kind and sensible attendance.

For the genuine malingerer, a diet of solid food should be provided, and, as far as possible, one likely to be constipating. This, with a liberal dosing of opium, and the watchful care of an intelligent attendant, will usually unmask the imposition. The passing of solid stools in the bed should be quickly and severely punished.

Jaundice.—The conjunctiva resists very successfully the efforts of the malingerer. If the adnata and the urine fail to present the peculiar characteristics of jaundice, we may reasonably suspect we have to deal with a feigned disease.

Of the substances used to produce a yellow stain rhubarb, curcuma, and tobacco-smoke are the best known. For the stain of the urine rhubarb is more commonly employed. The clay-colored stools can be produced by the daily use of a small quantity of muriatic acid. It must be remembered that in genuine jaundice there is general malaise, depression of spirits almost amounting to melancholia, and the jaundiced appearance is almost inimitable.

To prevent the examination of the eyes, impostors sometimes throw snuff into them to create inflammation.

Lameness.—The commonest form of imposition, especially among soldiers, is lameness, and one will see them hobbling up to sick-call to get excused from duty. The limping gait is the characteristic progression of the impostor. We see them everywhere in all countries, and the difficulty of detection is great.

The best possible method of detection is with anæsthetics, although sometimes the suggestion of a radical operation for the relief of an alleged contraction of a limb will bring the impostor to terms.

The detection of pain in general is often most difficult when a patient claims to be in suffering. We are forced to acknowledge that the proof of simulation is one we may not always be able to substantiate. Electricity will be found a very convenient diagnostic agent in such cases.

Neuralgia, rheumatism, lumbago, headache, affections of the hip and knee joints, gout, etc., are the diseases most frequently claimed by the impostor as provocative of the pain from which he appears to be suffering.

These malingerers know only too well that it is wellnigh impossible for the physician to say positively that there is no pain present.

By asking for a thorough description of the pain and by making a careful examination of the part supposed to be involved, we can arrive usually at some decision concerning its character, whether fraudulent or genuine. Patients who claim to be suffering from persistent pain, and who enjoy a good appetite, normal sleep, and who are not losing flesh, are very likely to be either imaginators or malingerers. Yet, on the other hand, we frequently meet with cases where pain is persistently claimed and probably present.

Marshall states that the simulation of pain is more frequently discovered by the inconsistencies and contradictions made in the history of the case than by diagnostic symptoms.

Myopia, Ophthalmia, etc.—The detection of feigned eye-diseases is a very difficult problem for the general practitioner to attempt. Myopia, ophthalmia, strabismus, are best referred to an eye specialist. Ophthalmia has been artificially excited with the application of stimulant remedies. While serving as surgeon on one of our large emigrant lines, I frequently discovered cases of ophthalmia. These I was obliged for the safety of the ship to isolate. Owing to the larger quarters and better fare given to my patients, I found now and then malingerers who wished to enjoy the privileges of the sick, but these I was able to detect with a little care and attention.

Night-blindness or nyctalopia (hemeralopia) has been mentioned in Beck's article on feigned diseases. Such cases are, however, very rare.

As suggested in the work referred to, it might be well to join a man suffering from this blindness with one who did not, so that they could work together. [See EYE AND EAR, Vol. III.]

Ozæna—Polypus Nasi.—These affections of the nostril are simulated "by impregnating a piece of sponge with some offensive juices or oils mixed with decayed cheese and putting the imbued sponge into the nostril in case of ozæna, and in nasal polypi by introducing the testicle of a young cock or the kidney of a rabbit into the nostril and retaining it there by means of a sponge fastened to it" (Dunglison).

Otorrhœa and fistula in ano have been simulated in the same manner.

Thorough cleansing and disinfecting of the part will usually enable us to detect the fraud.

Paralysis.—Paralysis is very seldom employed as a means of imposture. The pretended application of the actual cautery will usually suddenly give the paralyzed limb strength to move. Malingerers who are unable to get out of bed on account of pretended paralysis will sometimes be enabled to move under the influence of a strong electric shock.

It is related of Dr. Hutchinson that he gave one of these impostors, who claimed to have paralysis of the arm, fifty drops of laudanum in his tea. When sound asleep the doctor tickled his right ear with a feather and was rewarded by seeing the lame right arm rise instantly.

Shaking palsy may be suspected in patients presenting otherwise an excellent state of health. Very vigorous means are usually required to detect the imposition.

Porrigo.—By the use of nitric acid and other irritants, depilatories, etc., a very good imitation of scalled head or of porrigo can be brought about. The imposition is best discovered by a careful observation and restraint.

Prolapsus Ani.—A very rare simulation, which like prolapsus uteri is said to have been produced by filling a sac made from the intestine of an ox with a sponge saturated with a mixture of blood, milk, and sheep's brains.

Rape.—Occasionally some woman lost to shame will make the claim that she has been ravished. It is extremely doubtful if rape very often occurs without previous brutal assault, whether with or without weapons. Even the most timid and weakly woman is, generally speaking, able to prevent the forcible accomplishment of rape. Usually such people are women of loose character or of morbid imagination seeking pity and pecuniary assistance. Careful vaginal examination will usually detect the fraud and disclose the fact of their familiarity with sexual excesses. (See RAPE, Vol. II., pp. 456–458.)

Rheumatism.—The rheumatic malingerer is very apt to be a beggar or a soldier who complains of great suffering on moving the limbs and of pain and stiffness of the joints. Upon examination we are likely to fail to discover any wasting of the muscles of the affected limbs, neither is there any puffiness of the joints. The general condition seems to be fairly good with no appreciable fever and no increase of symptoms during the damp weather.

Lumbago, which is frequently practised, is likely to yield to heroic treatment in the shape of minute incisions or of hypodermic injections in the region of the complaint.

Scrofula—Scurvy.—Scrofula is seldom simulated by impostors. Occasionally cases are seen where ulcers have been artificially produced in the neck just below the angles of the jaw. The use of acrid substances will produce the necessary swelling both of the nose and the lips. The general scrofulous ulcer cannot, however, be imitated. Careful examination as to whether the ulceration be glandular and the discharge of a scrofulous nature will usually succeed in detecting the imposition.

Simulated scurvy seldom advances to a further degree than to induce a bleeding state of the gums by artificial means.

Tympany—Physconia.—Some impostors have been described as possessing the power of swallowing air so as to distend the stomach and simulate tympany.

Physconia is supposed to have been caused by swallowing toddy with large quantities of rice-water. Smart purgatives will usually enable one to remove either of the complaints.

Ulcer of the Ear.—Dunglison states that ulcer of the ear may be produced by introducing "a tent imbued with blistering plaster into the ear and repeating the application until the tube becomes ulcerated and a discharge of purulent matter is established.

The fetid smell is imitated by "dropping into the ear a mixture of empyreumatic oil, asafœtida, and old cheese; also by introducing a little honey into the meatus." By thoroughly syringing and disinfecting the ear the character of the imposition can be obtained.

Ulcers of the Leg, etc.—The old soldier with the sore leg is a familiar picture in military and naval hospitals. The acetate of copper, quicklime, and the juice of euphorbium or other acrid plants are some of the methods used to create factitious or fictitious ulcers.

In some instances these ugly sores are induced by rubbing the part, particularly the skin, with sand or rough wood. Pins are thrust through the bandage to keep up the irritation. As a means of detection we may conclude that artificial ulcers have usually more distinct margin. They are more readily healed than natural ulcers.

. **Urine, Bloody.**—This condition we find frequently in old hospital graduates, soldiers, and sailors. The imposition is practised by adding blood to the excretion, or by the use of substances capable of reddening it, such as prickly pear, beet root, madder, etc.

High colored urine may be produced by various stimulants, such as wine, cantharides, etc.

Besides the articles above mentioned, Dr. Coolidge states that black cherries, cochineal, and strawberries and logwood have been used by ingestion to redden urine.

Urine, Incontinence of.—The treatment of incontinence of urine in private practice is accomplished by the use of a catheter. The treatment of the simulated disease is also by the same method.

After a full dose of opium the catheter may be introduced during sleep, when it will be found that the urine has not drained off, and that the bladder retains the power of contraction.

Varicose Veins.—Varicose veins are so frequently found among soldiers and sailors and those who are in the habit of wearing belts that it would seem incredible to place this complaint among the list of simulated diseases. The condition is said to have been produced by ligatures placed tightly around the limb, and by the same method such a condition already existing may become aggravated.

Venereal Diseases.—This class of affections are rarely simulated except for purposes of blackmail. Gonorrhœa has been stated to have been simulated by the use of caustics. Artificial irritation of the genitalia to produce eruptions has been attempted by women for purposes of fraud or to excite pity. Soldiers and sailors occasionally make use of the knowledge acquired through personal experience to simulate venereal diseases, in order to obtain discharge from the service, or to escape hazardous service, marching, or other duties. We have frequently seen a wagon-load of soldiers excused from marching with the command on account of venereal disease, and very often a considerable per cent of these cases are simulated and succeed in escaping detection. (See RAPE, Vol. II., pp. 439-445.)

Vomiting.—In the malarial region of the department of the Missouri, I have seen many cases of soldiers who while suffering with "malaria" vomited with remarkable frequency. This symptom is made use of to simulate malarial fever.

Beck reports that some persons possess the power of expelling the contents of the stomach by pressing on the abdomen, others by swallowing air. This is made use of by malingerers as a symptom of organic disease. Foreign substances, even urine and feculent matter, have been vomited by females who have voluntarily swallowed them for the purpose of exciting wonder and pity.

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